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AND

AMERICAN RAILWAY JOURNAL.

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Life-saving kites, invented by Prof. J. W. Davis, were successfully tested near Newport, R. I., on April 24. A kite was sent in a 25-mile breeze from Brenton's Reef lightship to the shore, 1½ miles away, carrying with it a life-line. One mile of line ran out in 41 minutes. The two kites used were in the shape of six-pointed stars, 7 ft. in diameter, and covered with oiled duck. The first kite was attached to a float at the end of the life-line, and the other half a mile back of that. The life-line was manilla, ¼ in. diameter, rated to bear a strain of 780 lbs. This line terminated in a loop, and about 20 ft. back was slung a solid wooden 32-lb. buoy.

The Boston rapid transit problem has progressed to the point where the special legislative committee is to report upon a definite elevated route, following in the main the plan of Mr. C. C. Coffin. Through the crowded part of the city the route is mainly through a line of narrow alleys and small streets, and over some private property. The plan contemplates the extension of the elevated system to Roxbury. The city is to provide the roadbed and advertise for construction under three commissioners. After construction, the franchise for operating the system would be let for 25 or 50 years to the highest bidder who can deposit $1,000,000 of security. At the end of the lease the whole property is to revert to the city for ownership and control. The estimated cost of a two-track road is $1,000,000 per mile, and 5-cent fares will be required.

A plan for a system of protection for the city of Corning, N. Y., against floods in the Chemung River, has been presented to the Board of River Commissioners by Mr. Palmer C. Ricketts, Director of the Rensselaer Polytechnic Institute. He proposes the construction of dykes, aggregating 4.13 miles in length, made of clay and gravel, and 16 ft. and 10 ft. wide on top, with slopes of 2 to 1 on the river side and 1½ to 1 on the back. The total cost of the improvement, including engineering expenses and incidentals, is placed at $125,000. This plan includes a new span of 140 ft. to the bridge at Bridge St.

The total average daily supply of water furnished to London by eight Metropolitan water companies in 1891 was about 212,000,000 U. S. gallons, for a population of 5,518,745, or 38 gallons per capita. Of the total supply 53% was from the River Thames, 32% from the River Lee, and 15% from springs and wells. Only about 65% of the whole number of houses connected with the water systems have a constant supply, but the percentage is increasing.

To the end of 1891 the eight water companies had laid 4,818 miles of mains, supplying 780,210 houses; they had a total of 185 steam pumping engines, with an aggregate of 23,130 HP.; also 106 filters with an aggregate surface area of 108¾ acres, which filter the supply from the Thames and Lee rivers. The total capacity of the subsiding and storage reservoirs was about 1,820,000,000 U. S. gallons, of which only some 260,000,000 gallons was for filtered water. Gen. A. de C. Scott is water examiner, under the Metropolis Water Act of 1871, and Prof. E. Frankland is chemist. This information is taken from the report of the Local Government Board of England for the year 1891-2.

The new Cunard steamship "Campania" is compared as follows in the "Engineer" with some of her latest built Atlantic rivals:

Name.	Date.	Dimensions, in feet. Length over all.	Length B. P.	Beam.	Depth.	Gross tonnage.
Etruria	1885	520	501	57.3	38	7,719
City of Paris	1889	560	527	63.3	39.2	10,500
Teutonic	1889	582	566	57.8	39.4	9,860
Fürst Bismarck	1891	520	502	57.6	38	8,874
Campania	1893	625	600	65	43	12,950

For the same vessels the machinery, boilers, etc., are compared as follows:

Name.	Cylinders, ins. diam.	Stroke, ft.	Steam press. lbs.	I. H. P.	Trial speed, knots.	No. boilers.	No. furnaces
Etruria	One 71, two 105	6.0	110	14,500	19	9	72
City of Paris	Two 45, two 71	5.0	150	18,500	20	9	54
Teutonic	Two 43, two 68	5.0	180	17,500	20	16	76
Fürst Bism'k	Two 43, two 67	5.6	160	17,000	19½	9	72
Campania	Four 37, two 79 four 98	5.9	160	30,000	23	12	96

The unsystematic handling of the railway gage question in India, as noted in our issues of Oct. 24 and Nov 14, 1891, and May 26, 1892, is again emphasized by the statement in an Indian paper that the views of native authorities have been asked for in regard to the gage of the proposed Bhopal & Ujain Ry., in consequence of the Secretary of State being opposed to its construction on the standard gage, as proposed by the Indian government. The line will be a short one connecting a standard (5 ft. 6 ins.) gage line at Bhopal with a meter gage line at Ujain, but a short extension beyond the latter place would connect with a standard gage line now under construction, affording a route to the coast.

The following maximum limit of impurity for potable water was adopted by the Iowa State Board of Health on Nov. 3, 1892:

	Parts per 1,000,000.	Grains per U. S. gallon.
Total solids	600.000	35.000
Loss on ignition	Qualitative	
Chlorine	25.000	1.4579
Free ammonia	.080	.0046
Albumenoid ammonia	.150	.0087
Nitrogen in nitrites	Trace	Trace
Nitrogen in nitrates	4.000	.2332

The ordinance permitting the Waukesha Hygeia Mineral Springs Co. to lay pipes and supply water in all the streets of Chicago, noted in our issue of April 27, has been vetoed by the mayor, and his veto has been sustained by an almost unanimous vote of the council. The mayor very properly remarked in connection with his veto that the city had expended over $20,000,000 for water-works, and since it depended upon its revenue from them to meet the expenses of the system it could not afford to allow this revenue to be cut down by a private company.

Kankar, a word frequently seen in reports on public works in India, is a calcareous deposit found over a great part of the Punjab, at a depth of 3 to 6 ft. below the surface, and in strata varying from one to three feet in thickness. It is much used for road-making, and gives a very smooth surface. It lasts fairly well—the average age is from three to six years of heavy traffic, and from six to ten years under light traffic. This word is often spelled Kunkur.

Chinese highways can hardly be said to exist, says Mr. Kingmill, of Shanghai, in a paper read before the Asiatic Society. There are merely the customary tracks from one village to another; never macadamized and following all the irregularities of the surface. In the northern provinces, at least, the farmer has a perfect right to plough over any road passing through his land, and the teamster has an equal right to drive his wagon anywhere over the country. The result is sometimes a battle between the two; the building of pitfalls by the farmer in the line of old roads, running over crops by the teamster, and finally a compromise. Usually the tracks follow approximately in the same line, year after year.

Wire shafting for ships is suggested by Mr. S. P. Jerome, an American engineer. He proposes to cut a shaft 100 ft. long and 15 ins. in diameter into 5 sections. He would use for such a shaft 25,000 No. 7 steel wires, each 20 ft. long, and welded together at their ends to make a solid mass of steel upon which to fix couplings for bolting the sections together. Between the couplings the wires would be held in place by metal bands. He claims that each wire would sustain a load of 500 lbs. without rupture or injury; and the aggregate inherent strength would be 37,500,000 lbs., or 25 times the continuous force of a 5,000-HP. engine. Tests made show that when in rotation a tensile force is exerted upon each wire and its fastening, and hence the shaft can easily be designed to sustain any given stress, and its elastic nature would better adapt it to the bending of the ship, and eliminate the present danger to crank and engines resulting from powerful waves striking the propellor.

The most serious railway accident of the week was the derailment of a passenger train on the Gulf, Colorado & Santa Fe R. R. near Celeste, Tex., April 27. The train ran into a drove of horses, and the engine, tender, baggage and smoking car and chair car were derailed, the baggage car being telescoped by the tender, and the chair car overturned. Seven men were injured, one fatally, and six or eight of the horses were killed.

A locomotive boiler explosion occurred April 26 near Los Cerrilos, N. M., on the Atchison, Topeka & Santa Fe R. R. The engine was hauling a passenger train at the time. Two men were injured.

A bridge over Duck Creek near Dudley, O., on the Cleveland & Marietta R. R., was knocked down by a derailed locomotive April 20. The engine left the track on the approach, and struck the truss, and the engine and mail car went down, the passenger cars remaining on the track.—A partly opened draw at 92d St., Chicago, caused a freight engine of the Lake Shore & Michigan Southern Ry. to fall into the Chicago River. The bridge was nearly closed, and the engineman claims that a white light was displayed, but he had disobeyed the rule requiring all trains to be stopped before reaching the draw. The bridge tender fell into the river and was drowned.

One end of the 80-ft. iron highway bridge over the canal at Union and First Sts., Niagara Falls, N. Y., fell down April 25, owing to the giving way of the abutment.—The Missouri Pacific Ry. bridge over the Moreau River, near Tipton, Mo., was carried away by floods April 25.—A trestle on the Little Sawmill Run Ry. near Pittsburg, Pa., was broken down by derailed coal cars April 27.—The Clark St. drawbridge, Chicago, was damaged by a schooner running into it April 25.—A bridge on the Houston & Texas Central Ry. near Waxahachie, Tex., was damaged by fire April 16.—A severe storm in Indiana caused a freshet near Brazil, which damaged the bridges in that town, and washed out several stone bridges in the country.

The railways and canals of England, France and the United States are compared by Mr. A. V. Gude, President of the Engineers' Association of the South, in his recent annual address. We tabulate the figures, given in the text, as follows:

	United Kingdom.	France.	United States.
Total area, sq. miles	121,656	204,000	3,025,000
Population	38,740,000	38,427,000	62,885,500
Miles of railway in 1891	19,943	19,900	170,600
Miles of railway per 1,000	.515	.518	2.71
Miles inland waterway	3,813	10,385	3,348

A 10,000,000-gallon high-duty Blake pumping engine just put in for the Toronto water-works has been tested for duty on the heat unit basis, as recommended by the American Society of Mechanical Engineers. The engine was guaranteed to perform a duty of 110,000,000 ft.-lbs. during a 24-hours test. The actual average duty developed in a 61-days run was 112,357,700 ft.-lbs. Another Blake engine of the same size has just been ordered, which will make four high-duty Blake engines in connection with Toronto water-works.

A tall iron chimney has been built at Darwen, in the north of the county of Lancaster, England. The principal dimensions are as follows:

Total height, including foundation	279.80 ft.
From lower plate to summit	260.40 "
Top to bottom of cap	27.97 "
Difference in diameters, in cap	10.49 "
" " " in chimney	6.00 "
Number of rows of plates	66
Number of plates	308
Diameter of base-plate, in 6 sections	27.48 ft.
Number of rivets used	17,000
Thickness of brick lining at base	18 ins.
" " at summit	2¼ "
Time consumed in setting up plates, weeks	11
Total weight	1,116 tons
Total weight of iron	161 "

A chimney of the same height in brick would have weighed 304,500 tons. Two chimneys, in masonry, at Glasgow, are 467.7 ft. and 445.42 ft. high, respectively. But this Darwen chimney, and one of practically the same height, at Creusot, in France, are the tallest yet built in iron.

The Russian smokeless powder, made in the last eight months, according to Berlin reports, is found to become useless after being stored, and all attempts to restore it are so far fruitless.

RAILWAY IMPROVEMENTS FOR THE WORLD'S COLUMBIAN EXPOSITION TRAFFIC.

The prospects of a very heavy traffic this summer, consequent upon the attraction of the World's Columbian Exposition at Chicago, have led a large number of the leading railways, particularly those running between Chicago and eastern points, to provide additional track accommodation and rolling stock equipment, and large sums of money have been expended upon these improvements and upon terminal arrangements in Chicago. We give this week particulars of the work done by some of these roads, and shall follow them with similar particulars of other roads. While it is true that all the improvements described have not been made specially for the Exposition traffic, yet at the same time it is probable that the necessity of providing for this traffic has hastened the execution of work which might otherwise have been postponed to a later period. The arrangements and facilities for transportation between the city of Chicago and the Exposition grounds have been described in our issues of June 9 and Oct. 13, 1892. In providing for the local and short distance excursion traffic some roads have adopted special cars which can afterward be converted into freight cars. This has been done by the Illinois Central R. R. (Eng. News, Nov. 17, 1892) and the Northern Pacific R. R. and other roads have also provided special car equipment.

Illinois Central R. R.—The new city terminal station, fronting on the Lake Park and situated on what is known as Park Row, or at Twelfth St., was formally opened for business April 17, and the first train that went out was the Chicago and New Orleans Express, leaving at 2 p. m. on that day. Since then all the through passenger trains have started from the new station, though it is not absolutely complete, but all the train accommodations are sufficiently complete to enable them to be used. There are some finishing touches yet to be put on. All the trains of the Illinois Central R. R., the Cleveland, Cincinnati, Chicago & St. Louis R. R. and the Michigan Central R. R. are now using this station, which was described and illustrated in our issue of April 28, 1892. It has been erected very rapidly, ground having been broken in June, 1892, and the erection of the iron work commenced in October, 1892. It will meet all the requirements of the Exposition traffic and main line traffic, but some of the suburban trains will run beyond it into the old Randolph St. station. The work has been carried on under the supervision of B. L. Gilbert, architect; John F. Wallace, Chief Engineer of the Illinois Central R. R., and Mr. Downey, the contractor.

From Fifty-first St. to Sixty-seventh St. the tracks have been elevated, as described in our issues of June 9 and Oct. 13, 1892, and the streets crossed have been carried through the embankment by subways, the street grades being depressed to allow of sufficient headway. The road is being equipped with the Hall automatic block system from the new terminal station to Kensington, about 14 miles. The principal station of this road at the Exposition will be at the Midway Plaisance, and extensive alterations have been made to increase the passenger facilities at the Van Buren St. station, which will be largely used for the suburban and Exposition traffic. This station is in Lake Park, between the old terminal station at Randolph St. and the new terminal station at Park Row.

It is proposed to utilize the two eastern tracks for running the through trains between the Van Buren St. station and the Exposition. These trains will be made up of the special open cars illustrated in our issue of Nov. 17, and designed to be converted into fruit cars after the close of the Exposition. These cars are calculated to hold 96 passengers seated; 10 cars will therefore carry 1,000 people, and trains run on five minutes' headway could therefore carry 12,000 people per hour, or on two minutes headway 30,000 people per hour. In addition to this there will be the regular suburban trains which will run on the western tracks, and which, of course will carry a large number of passengers to the Exposition from intermediate stations. These cars do not accommodate as many people, their seating capacity being only 60 passengers, and it is not expected that these trains will consist of over six cars, which will carry, say, 360 people. These trains, run on five minutes' headway, would accommodate about 4,500 people per hour, or on two minutes' headway nearly 11,000 per hour.

The additional equipment purchased in connection with the Exposition traffic is as follows:

50 locomotives, at $7,900 each	$395,000
40 passenger cars, at $4,550 each	182,000
300 special Exposition cars, at $740 each	222,000
Total	$799,000

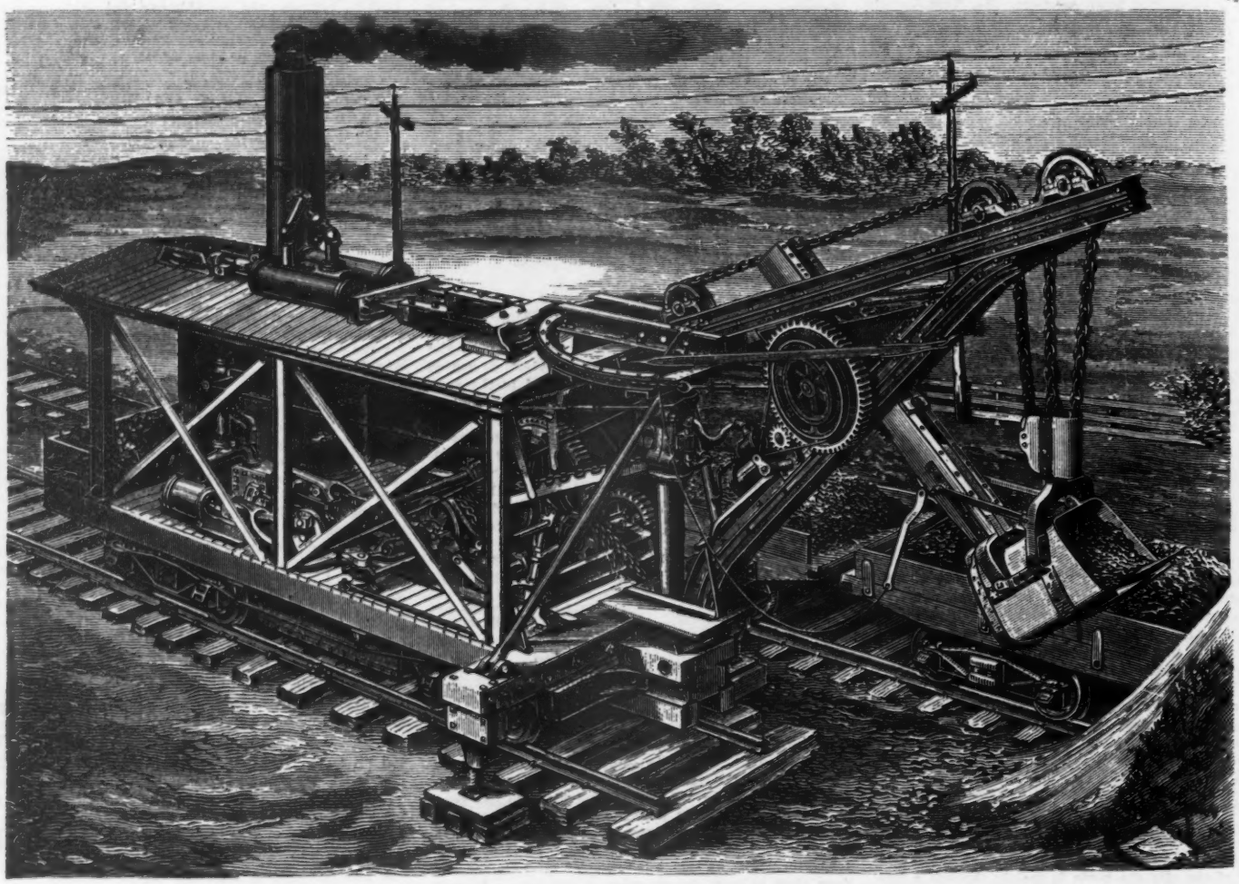


FIG. 5. VICTOR STEAM SHOVEL; TOLEDO FOUNDRY & MACHINE CO., TOLEDO, O.

The total cost of all these improvements has been estimated as follows:

New terminal station	$1,650,000
Elevating tracks (including additional tracks, platforms, fences, etc.)	1,350,000
Block signal and interlocking system	195,000
Locomotives and cars (as above)	799,000
Total	$3,994,000

The Illinois Central R. R. will not make any exhibits itself, but will aid in making exhibits from localities on its line. We are indebted to Mr. John Dunn, Assistant to the President, for much of the above information.

Pennsylvania R. R.—On the Pennsylvania lines west of Pittsburg, great efforts have been put forth in extending the double track, and over $2,000,000 have been expended on that work and other work in connection with it. Mr. James McCrea, Vice-President, states that the added tracks, including double track and sidetracks, will aggregate 150 miles in length. The road is making preparations for handling the increased passenger traffic, and the passenger car equipment has been increased about 25% and the locomotive equipment 10%. The train service will probably not be materially changed, as the road will run extra sections of regular trains to care for the additional business. The road will make an extensive exhibit, including

its standard track, signal plant, engines and rolling stock, as noted in our issues of Dec. 29, 1892, and April 27, 1893.

Chicago & Western Indiana R. R.—This road has now four tracks from the Dearborn St. terminal station to State St., the work having been completed in time for the Exposition, and the block system is now in operation. Two of the tracks will be given up to freight trains and two to passenger, with the block system in operation on all four tracks. All street crossings from Polk St. to Forty-sixth St. will be lighted and protected. Mr. B. Thomas, President, states that the total cost of the improvements made during the past year has been $2,000,000, the bulk of this being for the additional tracks between Forty-sixth St. and State St. The Chicago & Western Indiana is a terminal road, without equipment or trains, and furnishes terminal facilities for the New York, Lake Erie & Western R. R., Chicago & Grand Trunk Ry., Wabash R. R., Louisville, New Albany & Chicago Ry., Chicago & Eastern Illinois R. R. and Chicago, Santa Fe & California R. R. It furnishes its six tenants with all the accommodations they have in the city, including passenger facilities, outside and inside yards, team tracks, freight houses, etc., and charges them a rental for the same.

The Dearborn St. station, which is the Chicago terminal station for these six roads, has been largely overhauled and remodeled, and a second story placed on the baggage room 300 ft. long and 36 ft. wide, increasing the capacity of the baggage department from 3,000 to 10,000 pieces daily. All the baggage will be handled on Third Ave. Formerly incoming baggage was received on Fourth Ave., but this will now be made into a waiting-room for suburban passengers. The restaurant, which adjoined it, will be placed in the basement, with a wide stairway leading to it, and it is intended to make this a very elaborate dining-room and general restaurant. The room now occupied by the restaurant will be changed to an entrance for suburban passengers, and it is proposed to separate the suburban traffic from the through traffic altogether. The total increase in the passenger accommodation of the station is about 50%, and the increase in waiting-room capacity about 72%. A large annex to the main passenger yard will be constructed at Eighteenth St., where passenger trains will be made up whenever the main yard becomes too crowded. This will facilitate the handling of cars and obviate the danger of a blockade during times when all the roads are carrying passengers to their full limit.

Chicago & Eastern Illinois R. R.—This road has increased its passenger equipment over 30%. The line is now double track from Chicago to Danville, a distance of 124 miles; 74 miles of additional double track have been built and completed lately. The line will handle a large southern business during June and July in addition to the regular traffic from along its own route. The additional traffic on account of the Exposition will be handled by means of added sections for the regular passenger trains, and probably two regular trains will be added to the present schedule as soon as the Exposition traffic develops. Mr. M. J. Carpenter, President, states that it is doubtful if the road will run its excursion trains directly into the Exposition grounds. The terminals are in the hands of the Chicago & Western Indiana R. R. It is stated that the new equipment will be of the latest improved patterns, and that the road is fully prepared for all the business coming to it. The road will not make any exhibits.

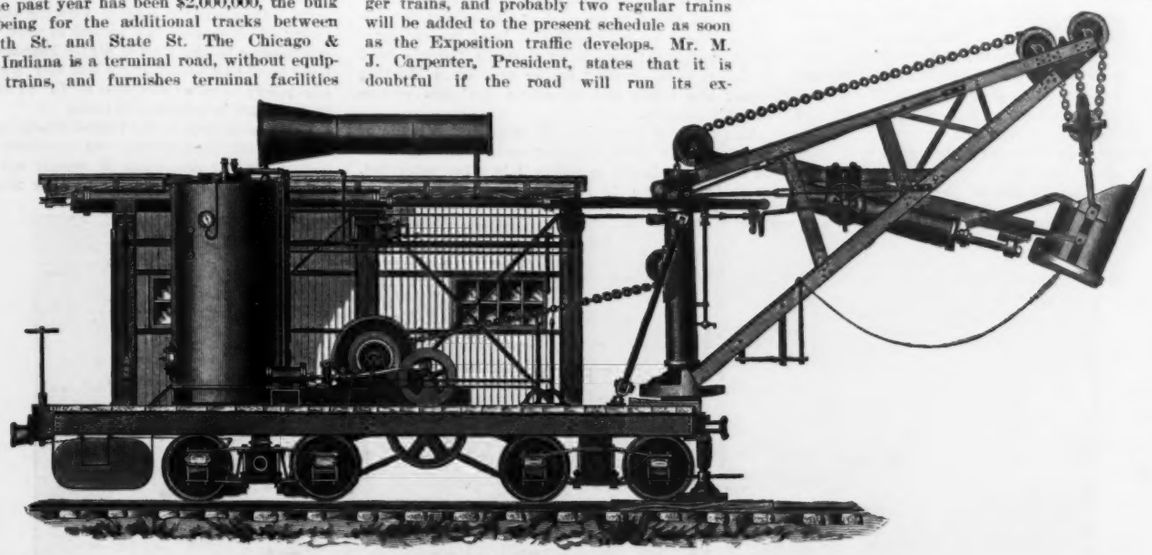


FIG. 6. CLEMENT STEAM SHOVEL; INDUSTRIAL WORKS, BAY CITY, MICH.

STEAM SHOVELS AND STEAM SHOVEL WORK.*

By E. A. Hermann, M. Am. Soc. C. E.

Part I.—Steam Shovels.

(Continued from p. 388.)

The most used, and hence the most important part of the machinery of the steam shovel is the gearing imparting motion to the hoisting drum, actuating the chains by which the dipper is raised and lowered. It is in almost constant use, and is often subjected to severe shocks in hard digging. Of all parts of the machinery it is the most likely to break or rapidly wear out. Naturally it has received the most attention of any part of the steam shovel in all efforts to improve the design, strength and durability of the machine. There are a number of different gears in use, and essentially they are either friction clutches or positive gearing. The use of the former subjects the machinery and crane to less severe shocks, and can be thrown in and out of gear more rapidly, but it wears out quicker, often causes delay by heating, and requires frequent repairs. Positive gearing exposes the machinery and crane to more severe shocks in hard digging, and must be started slower, especially in hard material, but while these machines are a little slower than those operated with friction clutches, they are less subject to the expense of repairs and delay due to the disarrangement of the hoisting gear, so that their total output of material about equals, and sometimes exceeds, the quicker moving friction gear machine.

The mechanism for thrusting the dipper into the bank is attached to the crane, and the forms most generally used are as follows:

1. A chain, one end of which is attached to the rear end of the dipper handle, and the other end wound around a drum receiving its motion by an endless chain passing over a sprocket wheel connected to the axle of the sprocket wheel at the top of the mast, over which the hoisting chain passes, thereby revolving both wheels. This drum is thrown into gear by a friction clutch, and its motion regulated by the cranesman's lever and footbrake.

2. A rack on the dipper handle operated by a pinion attached to a shaft revolved and regulated as above described.

3. A small double cylinder engine operating either a pinion and rack as above described, or revolving a drum with a chain attached to it and the rear end of the dipper handle as described in the first case.

4. A long steam cylinder attached to the dipper handle, whose piston rod is connected to the dipper, extending or withdrawing it as desired.

The thrusting mechanism used in the last two cases imparts a rapid, steady and powerful motion, but the extra engines or steam cylinder and their connecting steam pipes involve a complication which often more than balances their advantages.

Swinging the crane in a horizontal direction is generally accomplished in one of the following three ways:

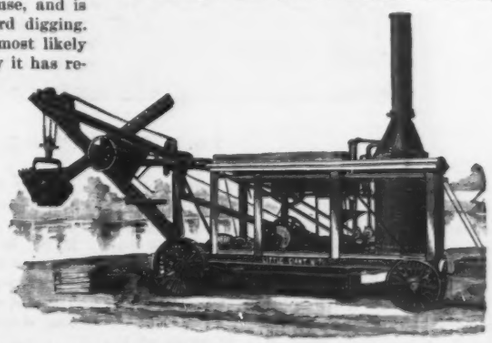


FIG. 7. GIANT STEAM SHOVEL, AND FIG. 8. LITTLE GIANT STEAM SHOVEL; VULCAN IRON WORKS CO., TOLEDO, O.

* Copyright, 1893.

1. A chain passing around the swinging circle attached to the post, and wound around drums connected to the engine by positive gearing or friction clutches.

2. A wire rope passing round the swinging circle and connected to the piston rods operated by two long steam cylinders.

3. A chain passing round the swinging circle and wound around a drum connected to a small reversible engine.

The mechanisms used in the last two cases have the same advantages, but also suffer from the same objections urged against employing small engines or a steam cylinder for thrusting the dipper into the bank.

The engines are either of the upright type with a single steam cylinder, or of the horizontal type, with double horizontal steam cylinders. The size of the cylinders varies for machines of different capacities, ranging from 8×10 ins. to 10×12 ins. for the upright engines, and 6×8 ins. to 13×16 ins. for the horizontal engines.

The upright type of boiler with submerged flues is usually preferred, as it occupies only a small space. Horizontal boilers of the locomotive type are used in a few machines, and are more economical in the use of fuel, but occupy too large a floor space. Forced draft is used in both types of boilers, and they are generally worked to the limit of their capacity. The usual working pressure is 90 lbs. per sq. in. The safety valve is generally set to blow off at 120 lbs. per sq. in. The boiler is supplied with water either from an upright circular sheet iron tank located in a corner of the machine, behind the boiler, or from a sheet iron box tank hung under the floor. These tanks usually hold about 1,000 gallons of water, enough to run the machine half a day. The water is obtained by a pump or siphon from the tender of a locomotive on railway work, or is hauled to the machine by wagon on other work.

In some machines the frame or car body is made of wood, generally oak, often incased with heavy plate iron. In others it is constructed of iron or steel I-beams and channels. In all machines it is strongly built and braced with a view to sustain the weight of the working parts and to resist the shocks to which it is subjected. The floor is usually of 3-in. oak plank.

The mast or post is made of cast or wrought iron, strongly braced and guyed to the frame. It is the pivot about which the crane swings, and easy working in its bearings is of great importance for the rapid and economical operation of the machine. In order to prevent breakage or delay it should never be permitted to wabble by neglecting to promptly tighten its braces and guys in case they should work loose. The post should always stand vertical, or practically so, to insure the horizontal motion of the crane and avoid unnecessary straining of the swinging gear. For this reason the machine should be set practically level before beginning operations; and using a small mason's level is better than trusting to the eye, when blocking under the track and adjusting the jack screws for this purpose.

The crane is secured to the post, and is made of wood, iron or steel, strongly and compactly built to resist the shocks to which it is often subjected. It is from 14 to 20 ft. high above the track or ground, varying with machines of different sizes and manufacture, and swings horizontally through an angle of 180 to 240°, with a radius of 15 to 20 ft. In some machines it must be detached from the post for shipment, in others (mostly those made for railway use exclusively) it can be lowered to a height of 14 ft. above the track, thereby permitting shipment without detaching from the post.

(To be continued.)

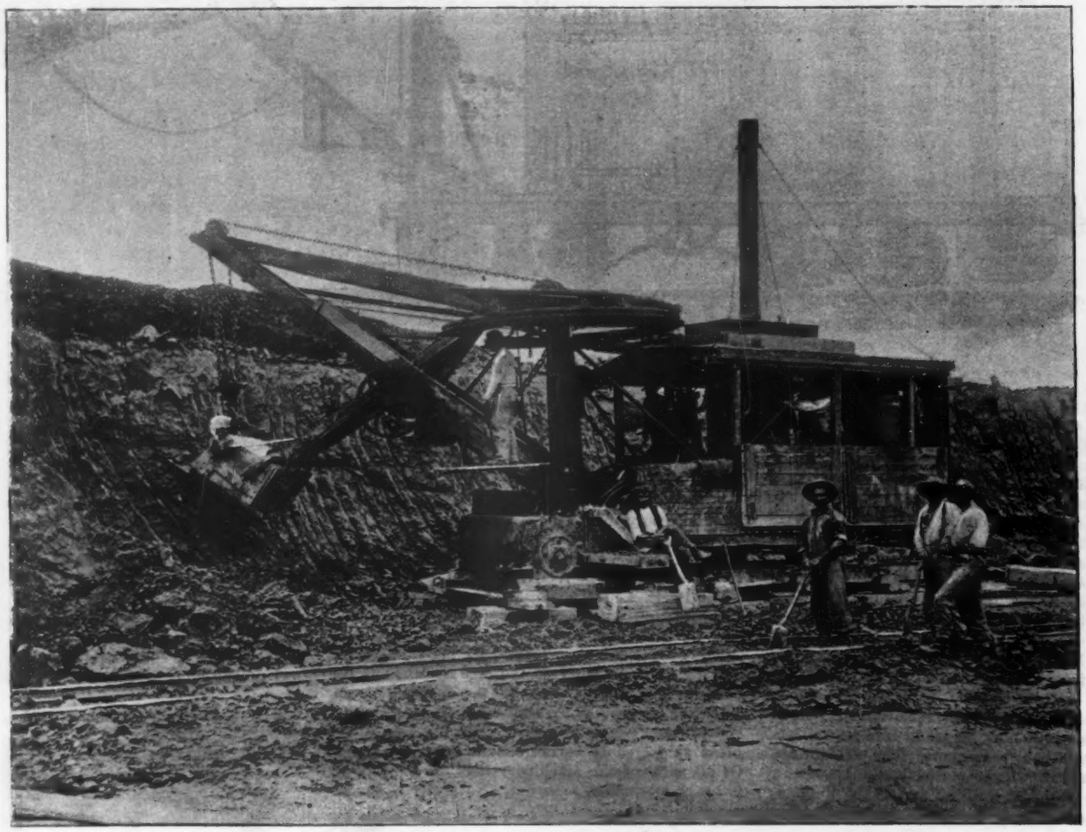


FIG. 9. OTIS-CHAPMAN STEAM SHOVEL; JOHN SOUTHER & CO., BOSTON, MASS.

ICE HARBORS IN THE DELAWARE RIVER AND BAY.

By A. Stierle, Assistant, U. S. Engr. Dept.

(With inset.)

The late severe winter, with the daily accounts from many of the shipping ports north of the 35th parallel of the complete interruption of navigation by ice, have awakened a renewed interest among commercial bodies, shippers, seafaring men and engineers connected with river and harbor works on the subject of protecting vessels against ice and the means of preventing, to a certain degree, the incalculable loss to which commerce is subjected by this interruption. In a reciprocal relation to this subject are brought forth the elementary investigations that have been made concerning the strength of ice and the practical application of the results in the construction of works exposed to the various forces exerted by ice when in motion or at rest, by impinging blows, by statical pressure, or by expansion and contraction. In Engineering News, Jan. 12 (p. 37), reference is made to the paucity of technical literature on this subject. Whoever has had occasion to seek information in this line will readily corroborate this statement. This paper is written with the object of relating some experiences gained in this branch of engineering by the United States Engineer Department on the Delaware River and Bay, and incidentally refers to other localities so far as information is accessible in published reports.

There is no river in the United States upon which the General Government has expended as much money for the protection of vessels against floating ice as the Delaware River. The first attempt in this direction was made more than a hundred years ago, when Philadelphia was the commercial metropolis of the country. Philadelphia is 98 miles from the sea by way of the bay and river. In the upper Delaware, heavy ice gorges often occur; but impediments to navigation from that source are not so frequent between Philadelphia and the sea, as the fan-shaped configuration of the shore and the channel seem to facilitate a ready movement of floating ice at all stages of the tide. It is only during exceptionally severe winters like the one just past that the accumulation of floating ice in large masses during a continuous period of low temperature forms compact fields completely blockading the river from shore to shore. This occurs about once in ten years. But the necessity of sheltering vessels against running ice, even when the winters are comparatively mild, has long been apparent, especially so in olden times when vessels were small and iron hulls unknown.

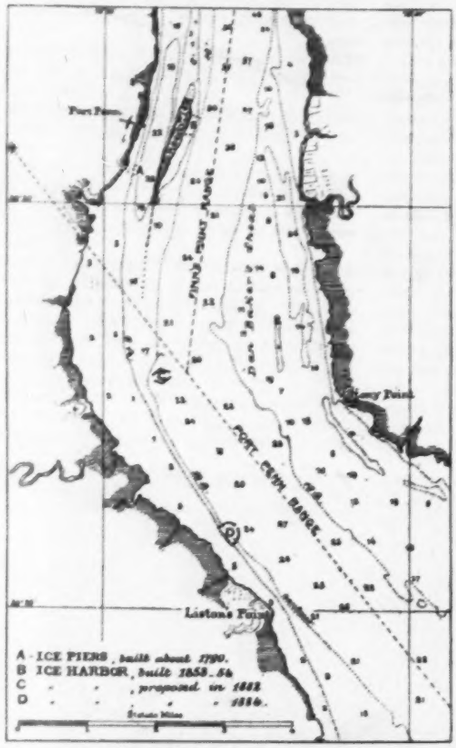
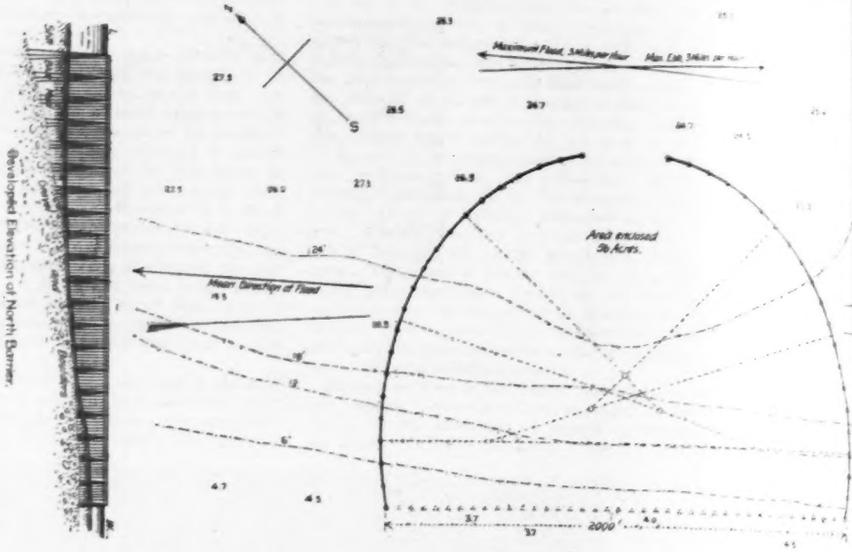
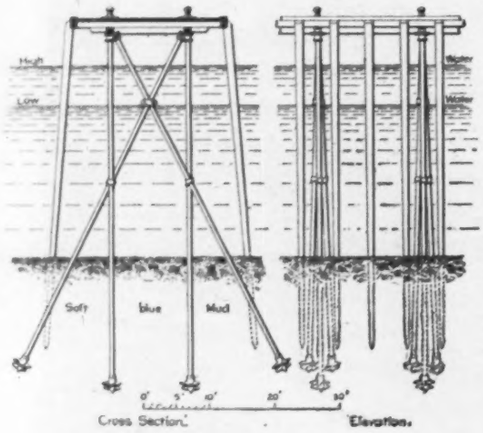


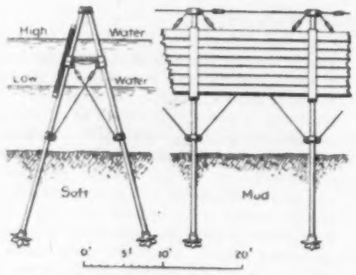
CHART OF HEAD OF DELAWARE BAY.


Developed Elevation of North Barrier.
Maximum Flood, 3 Miles per Hour
Mean Direction of Flood
Area enclosed 56 Acres.
2000'

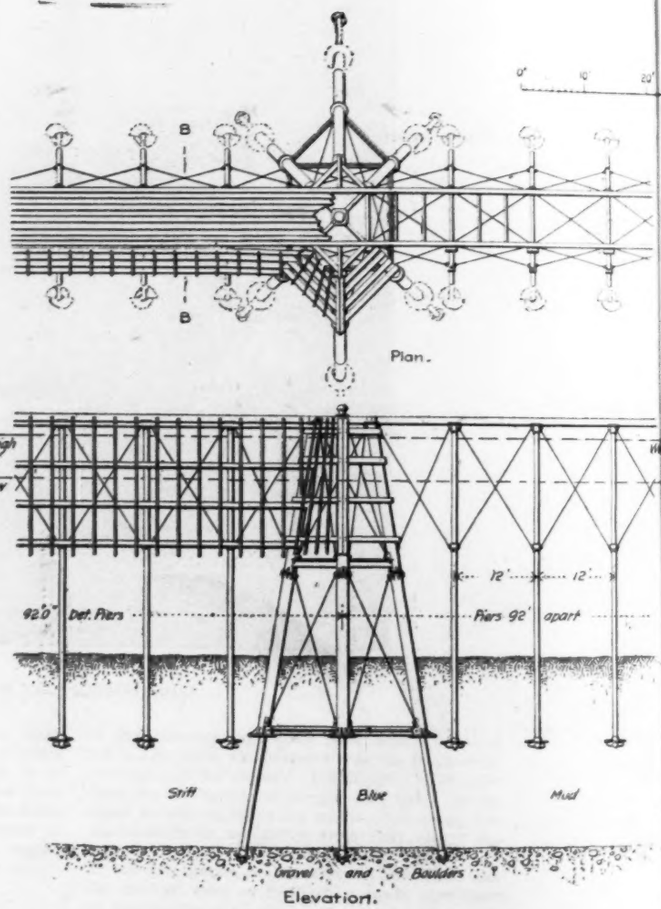
Plan.



ICE PIER, DESIGNED BY COL. LUDLOW

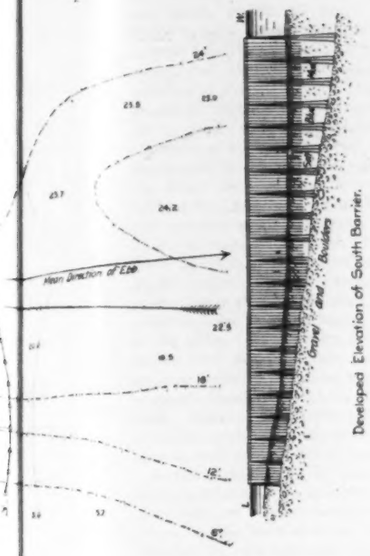


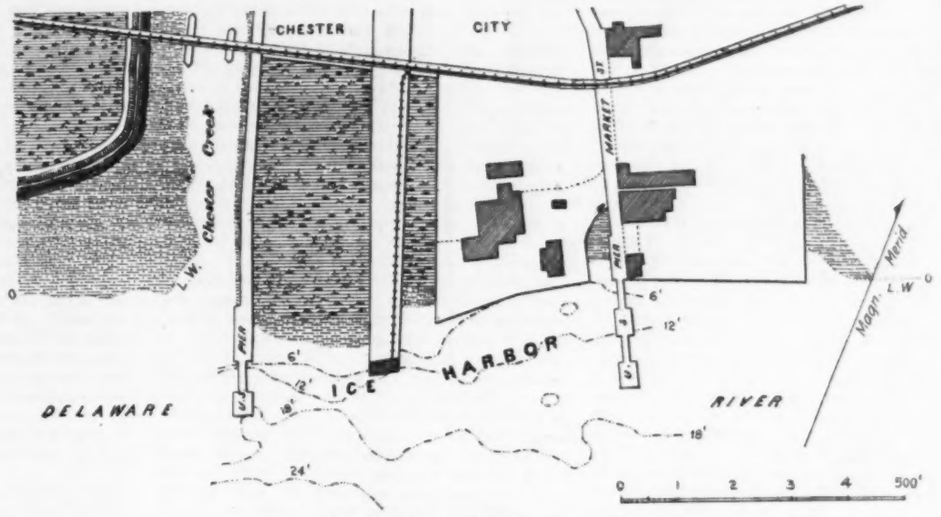
ICE BARRIER, DESIGNED BY COL. KURTZ.



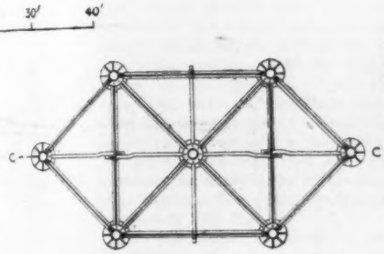
ICE HARBOR AT HEAD OF DELAWARE BAY, DESIGNED IN 1884 UNDER DIRECTION OF MAJOR W. H. HEUER, U.S. E

ICE HARBORS IN DELAWARE BAY; Designed and Built

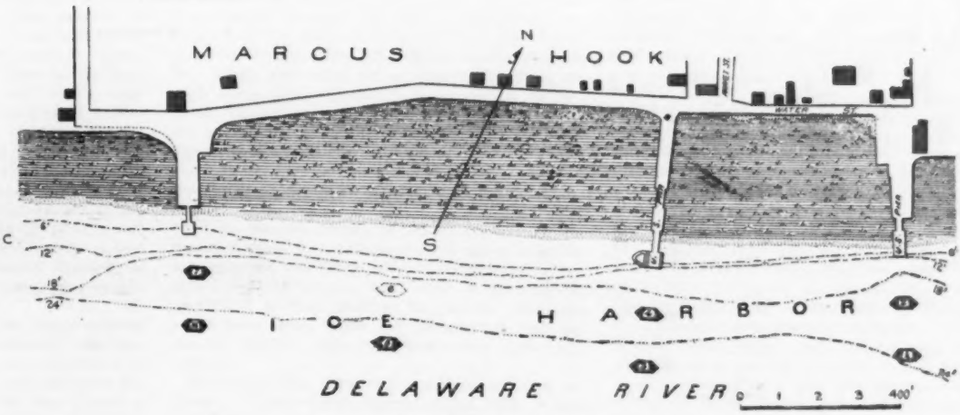




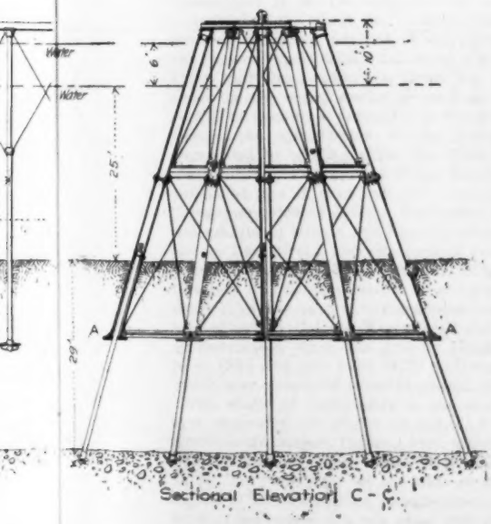
ICE HARBOR ; CHESTER, PA. 1879.



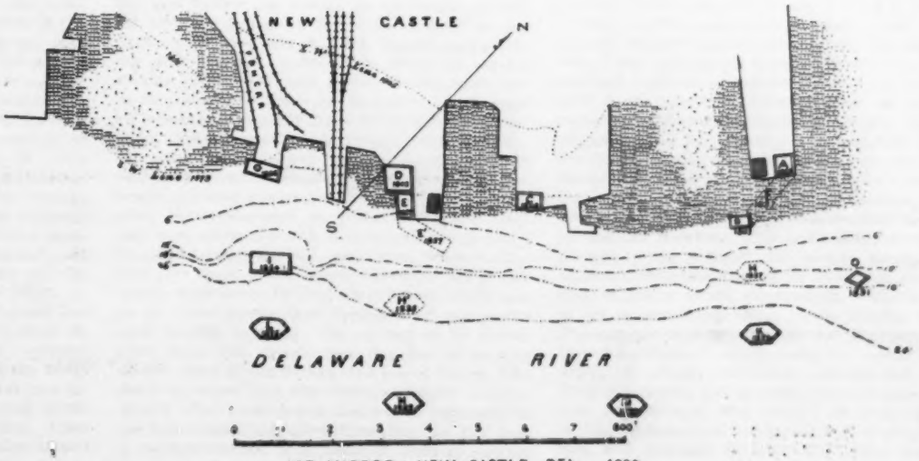
Sectional Plan at A A



I E HARBOR ; MARCUS HOOK, PA. 1893.



Sectional Elevation C - C



ICE HARBOR ; NEW CASTLE, DEL. 1893.

EUER, U.S. ENGINEERS, BY A STIERLE, ASSISTANT ENGINEER.

and Built under Direction of Engineer Department, U. S. Army

The first ice harbor was constructed some time during the last century near Port Penn, Del., in the channel between Reedy Island and the western shore, about 45 miles below Philadelphia. There is no authenticated record of the projectors or who bore the expenses of building the protective works, but as Delaware was then a part of the province of Pennsylvania and as the harbor was undoubtedly planned for the benefit of vessels in transit to and from Philadelphia, it is likely that Pennsylvania paid the bill. The sheltered area was protected on the up-river side by two and on the lower side by four wooden crib piers, filled with stone, and was about four acres in extent; the greatest available depth in the harbor being 12 ft. at mean low water. The piers stood about 80 ft. apart in a line normal to the shore, and were 30 ft. square with the exception of the outer one of the lower row, which was 70×41 ft. There appears to have been no batter or slope to the sides of the cribs. All the piers were long ago cut down to the level of low water, mainly by the ice; and as they formed a standing menace in this condition to small vessels and boats, they were removed in 1883. Some of the timbers taken out consisted of chestnut, poplar and black gum, measuring 16 ins. square, and were perfectly sound.

At the beginning of the present century the movement to increase the number of ice harbors on the river assumed a more definite shape, two additional points having been selected for that purpose, viz., Chester, Pa., on the north shore, and New Castle, Del., on the west shore, the former 17 miles and the latter 34 miles below Philadelphia. Both of these places were closer to the main channel of the river than Port Penn, and both were then towns of some importance. About 1803, four ice piers, marked A, B, C and D on the chart of the harbor, square wooden cribs filled with stone, were erected in New Castle harbor by the United States. Pier B stood 150 ft. beyond low water-mark, and the extent of the sheltered area was about 2½ acres. In 1827 piers E, E' and F, of similar construction, were added. They seem to have been built for the purpose of closing the harbor at the upper and lower end; and as they practically cut off all the currents that had previously passed through the harbor, the latter rapidly shoaled, so that within a few years the low water line moved out nearly 200 ft.

In 1835 Major Delafield, of the Topographical Engineers, commenced the extension of the harbor by building pier H, which was completed in 1837, and by beginning pier H' and partially finishing it. About the same time the New Castle & Frenchtown R. R. Co. built pier G, a short distance beyond the wharf line. Major Delafield also removed the upper portions of old piers B and C and replaced them with a cut stone superstructure. From that time, therefore, dates the use of cut stone for the upper works of ice piers, and also, as will be seen by a reference to the sketch of the harbor, the introduction of the hexagonal plan augmented by sloping sides. In 1854 the square wooden crib I was built by Major Sanders and the unfinished pier H' was removed. A plan was also in contemplation to enlarge the harbor by building two additional square wooden crib piers outside of and in line with I and one beyond pier H. This reverting to the old style and plan of construction certainly was not a progressive movement. Twenty years later the plan of enlargement was partially carried out by Colonel Kurtz, who placed a stone superstructure upon the crib I; constructed pier K in 1874 and pier L in 1875; and began pier M, which was completed after his death, in 1879.

The shape of these piers is the hexagonal one first suggested by Major Delafield, but their dimensions are larger, the long axis, which is parallel with the current, being about 84 ft. and the width 42 ft., the "starlings" at the ends of each pier being 90°. The foundation or substructure up to the level of low water is a crib filled with stone. Upon that is placed the superstructure of granite, backed with closely laid rubble, which reaches to a height of 10 ft. above the crib. To give more protection to the harbor from the river side, pier M was built about 140 ft. beyond and 270 ft. below pier K, the outermost pier of the upper row; and pier N, of the same dimensions, was consrtucted in 1882 by Colonel Ludlow at another point similar in location with reference to the lower row of piers, thus bringing the protective works to a symmetrical completion. Both of these piers stand in 29 ft. of water, and the area of the harbor is now 6 1-5 acres, of which about two acres are too shoal for vessels drawing more than 12 ft. of water.

During the year 1891 General Smith removed pier H, built in 1837, to afford more anchoring ground in the upper section of the harbor, and also erected pier O. The latter is quite different from those previously constructed. It is much smaller in length and width; is rhombic in plan instead of hexagonal or square, and has a similarly shaped wooden crib foundation capped with a superstructure or casing of boiler iron filled with concrete. It was constructed for and put in place within a period of three months at the contract price of $9,000. The expense for building one of the stone ice piers had varied from $17,597 to $22,949, and their construction required, in several cases, two working seasons. It is very difficult to ascertain the exact amount of money expended in 1803 on piers A, B, C and D, but assuming it to have been $20,000 the total amount expended by the United States on this harbor up to date is $244,937.

This harbor has been described somewhat in detail because it, more than any of the others, shows plainly the various phases of transition through which it passed before it arrived at its present state. It illustrates also how little was foreseen in early times to what magnitude the needs of commerce and of navigation would grow in the near future.

The construction of an ice harbor at Chester, Pa., 17 miles below Philadelphia, was begun at the same time as that at New Castle, about 1803. Two lines of wooden cribs 700 ft. apart, were projected from the shore, three piers forming the upper and two the lower line. The piers measured about 50×30 ft. and were set at intervals of 51 ft., each series being connected by a narrow bridge. From the two innermost piers causeways led across the marsh to the main shore. The harbor soon commenced to fill up at its base; the originally much larger area is now reduced to 2½ acres, and the depth of water at the heads of the piers decreased from 20 ft. to 15 ft. at low tide. The riparian owners along the shore constantly encroached upon the available harbor space by erecting wharves and piers, and as apparently no restriction could be put upon them it was recommended in 1870 to abandon the harbor, which has since been done, after the government had expended $26,571 upon its construction and maintenance.

Simultaneously with the beginning of the extension of New Castle harbor, about 1852, it was proposed to establish a new ice harbor further down the river, to compensate in part for the one destroyed and abandoned below Port Penn. An appropriation of $51,000 had been made by Congress and construction was begun the following year. The new harbor was located in the vicinity of the old site, but nearer to the main channel of the river, on the east side of Reedy Island, and about one mile further north. Two rows of oblong wooden piers filled with stone—in this case two on the upper and three on the lower side—formed an inclosure of a space 2¼ acres in extent, behind which vessels could seek refuge from the ice. The cribs stood detached from the shore and about double their width apart. At the outer piers the depth of water was about 15 ft. The three lower piers were completed to above high-water level and were connected with each other and the shore by a light gangway, laid upon closely driven piles. The two upper piers, though raised to about low water, were never finished for want of funds, and as no more money was appropriated the works went rapidly to decay. On account of its incomplete state few vessels took the risk of seeking shelter there during the heaviest run of the ice. The depth of water had also become speedily reduced shortly after construction had begun, especially at the lower piers, and notwithstanding the fact that a recommendation was made in 1870 to enlarge the harbor by the addition of eight stone piers at an estimated cost of $190,000, nothing further has been done and the location is now abandoned.

The establishment of an ice harbor at Marcus Hook, Pa., situated 4 miles below Chester and 21 miles below Philadelphia, is of quite recent date. It was begun in 1867; the deterioration of that at Chester and the difficulty experienced there to obtain control over the shore in order to regulate the encroachments of the riparian owners, forced the change to another point. The original plan resembled in its general arrangement the other ice harbors described above, and consisted of two landing piers of wood near low-water mark, about 600 ft. apart, each connected with the shore by a bridge and causeway, and of four detached ice piers, hexagonal in shape, with an extreme length of 74 ft. up and down stream and a width of 32 ft., the top being about 3½ ft. above common high-water level. The piers are similar to those erected in New Castle harbor by Major Delafield, and were completed in 1877. They protected a harbor space of about 3½ acres with an average depth of water of 18 ft. at low tide. As in the other cases, the harbor proved to be entirely inadequate to the demands made upon it during the winter by the yearly increasing of shipping, and in 1880 Colonel Ludlow, having been instructed under an order from Congress to make a general examination of the ice harbors on the Delaware River, proposed a plan for its enlargement comprising the construction of three additional ice piers on a line 600 ft. below the lower piers and dredging the base of the harbor between high and low-water mark at a depth of 18 ft. It was calculated that the harbor area would thus be increased from 3½ to 14 acres. Two of the proposed piers, Nos. 5 and 6, were completed in 1881; the third, No. 7, was built in 1884, under a modified project which extended the harbor still further down the river, opposite to a long private wharf previously built there, thus forming the base of a fourth line of piers. During the year 1887 pier No. 6 was entirely removed, the superstructure being afterward used in the construction of a new pier, No. 8, placed in line with and outside of No. 7. The harbor in its present condition has an area of 10 acres with a depth of from 25 to 18ft. over about 7½ acres and from 18 to 12 ft. over the remaining 2½ acres. Its construction and maintenance have cost the U. S. government up to date $212,874.

Long before any of the above harbors were completed, it had become apparent to those interested and to the officers in charge that their total available capacity was not equal to the demand and that further extensions or additional provisions should be made for protecting the growing tonnage of the river during the ice season. The ice harbors already provided for were originally planned upon a small scale commensurate with the existing demands. Their enlargement later proved to be expensive work, and of necessity lacked uniformity in execution. For a time the restoration of the harbor at Reedy Island and the construction of a new one at some point above Chester were seriously considered. The majority of those closely connected with maritime commerce seemed to favor the location of a new harbor at the head of Delaware Bay, especially between Reedy Island and Liston's Point, a stretch of over 7 miles in length. Colonel Ludlow, who had at once taken great personal interest in the movement for the elaboration of the existing ice harbors on this river, and who had made an exhaustive report upon the subject* finally suggested Liston's Point, or the bay immediately above, as the proper location. He also suggested that the inclosing works of such a harbor should be entirely detached from the shore and should consist of lines of piers having a decking above high water, resting upon iron screw piles. The advantages of such a construction he summarized as follows: "The work once begun may proceed in any weather; the harbor is capable of indefinite extension as may be found desirable; the open character of the substructure, while the flow of ice is prevented, offers no obstruction to the free passage of tidal currents, and the harbor will therefore require no dredging to maintain its depth. It affords continuous passage for sailors from end to end, and as many points of mooring as may be required. The cost of an iron structure of this character will not exceed that of stone piers, and will probably be less. The stone piers are necessarily somewhat widely separated and present comparatively few points for mooring; they interfere with the flow of water and create powerful eddies; they are reached only by boat and access to them is frequently difficult or even impossible at the very time when, from the pressure of running ice, their shelter and support are most needed.

* "Report of Chief of Engineers, U. S. Army, 1880," p. 612.

The construction of their timber foundation to low water and the laying of the stonework above are tide-work and therefore tedious and uncertain. Operations can only proceed during favorable weather, and the pier, until completed well above high water, is a danger to shipping. It might furthermore, be stated that the lines of pier, having a continuous deck, afford opportunities for the placing of lights accessible one from the other, and of storing temporarily, wholly or in part, the cargo of vessels, if necessary. Other conveniences, such as supplies of coal and provisions, suggest themselves."

Hitherto ice harbors had been constructed in two ways, first, by forming an inclosed basin at some suitable locality, in which vessels could take refuge when the ice began to move, or, second, by sheltering a certain space of the river with isolated piers called ice breakers, that would prevent the heaviest "shove" of the ice against vessels lying behind them, the entering of broken fields of ice in motion being considered of no consequence. The first plan, tried at Chester and New Castle, has not been very successful. The defects of the second plan have been referred to in the quotations from Colonel Ludlow's report. It may be added that these ice breakers are costly in the first place, and although many of the older piers have withstood the ice of many winters and are covered with iron plating at the corners of the crib, the timbers are being slowly abraded by the combined action of currents and ice and their destruction must soon take place.

A number of ice harbors on a smaller scale have been built by the United States Engineers during the past 20 years on many Western rivers, particularly on the Ohio.* A few are closed basins; but the majority are open harbors, often under the lee of a projecting point of the shore, protected by piers or ice breakers, consisting of square wooden cribs filled with stone, the up-river side sloping back at an angle of 45°, costing from $3,000 to $6,000 apiece; from two to four being considered sufficient for a harbor. They are erected on the up-river side of the protected area, in a single row, either normal or oblique to the shore, at intervals equal to their width. This single row affords all the required shelter, as the current is always in one direction, whereas on the Delaware, which is a tidal stream, the upper and lower limits of the harbors must be protected. I have not been able to ascertain from the reports the life of these crib piers on the Western rivers; the fact, however, that their construction goes on proves that nothing better has been devised and that they give a certain satisfaction.

Heretofore it has been a generally adopted maxim that nothing but the heaviest structures of stone or wood could be relied upon to endure the blows received from floating ice fields. Yet, ever since Mitchell invented the screw pile, many lighthouses and landing piers have been erected upon screw piles in Northern climates and have withstood the onslaught of the elements. Encouraged by the experiences gained at the iron landing pier, in the Delaware Breakwater Harbor, the first one of its kind built in the United States upon screw piles,* Colonel Kurtz, who had designed it, had as early as 1872** taken a step in advance and proposed iron ice-barriers upon screw piles. This was in connection with a plan then under consideration, for "the prevention and removal of ice obstructions in the 'Horseshoe' of the Delaware River," six miles below Philadelphia. The ice-barriers were to form training walls, whereby the movements of the ice could be controlled and its tendency to accumulate in solid packs upon the adjacent shoals counteracted, and were to be set parallel with the current along each side of the main channel, beginning at some point of the shore above the locality in question. Their combined length was 7,500 ft. As will be seen by referring to the accompanying sketch, it was a very light structure to be exposed to heavy ice-jams, but Colonel Kurtz says in his report on the subject: "I have formed an opinion that a simple open barrier of iron will be more effective without hazard of injury to the channel, to the health of the shores and the vested rights of the owners, and will be of less cost than either a solid barrier of crib-work filled with stone or earth, or detached ice piers formed of the same material." It was known that in any case the improvement of this shoal would involve a large expenditure of money; when, therefore, during the following winters the three iceboats employed by the city of Philadelphia were successful in maintaining an open river, the erection of these barriers was not further considered.

In making his final selection of a location for the new harbor, Colonel Ludlow stated that "the necessity of this harbor to the navigation of the Delaware, particularly during the winter season, and from three to five months of the year, has been urgently pressed upon the attention of this office by the various commercial interests. It is hazardous even for an iron steamer to anchor when exposed to the pressure of moving ice, and there is no doubt that the construction of suitable ice harbors, and especially one near the head of the bay, is, next to the permanent deepening of the navigation, and even taking precedence of this in winter, the most valuable improvement needed for the commerce of the Delaware River."

The most advantageous position indicated by the chart was found to be a little outside and westward of the intersection of the Port Penn and Finn's Point ranges, a location easily accessible to vessels requiring its protection, whether on the outward or inward passage. Colonel Ludlow's design for the inclosure of the harbor shows two lines of continuous pier-work, each line 1,076 ft. long, placed opposite to each other and at the outer ends 600 ft. apart, sheltering an area of 19 acres. Each line forms in reality two wings of equal length meeting at an angle of 120°, the angle of the upper line pointing up and that of the lower down stream. The outline is, therefore, rhombic, which permits a more ready flow of the ice past the exterior. The details of the piers are quite novel, as will be seen by the drawing on the inset sheet. Each pier consists of 68 bents of screw piles, 16 ft. apart, each bent having four piles, two in a vertical and two in an inclined position, the latter crossing the vertical piles at about mid-length and crossing each other under the axis of the pier, the heads extending to and fastening into the cast iron caps of the opposite vertical piles. At the intersections suitable wrought iron clips hold the piles firmly together. Hollow steel piles, 7 ins. diameter, were proposed, provided with large cast iron screws. Over the whole extends a yellow pine decking 24 ft. wide, and on both the interior and exterior wooden fender piles about 5 ft. apart protect the structure. The security of vessels is further provided for by iron mooring posts upon the deck of the piers and by anchor buoys in the harbor.

Shortly after Colonel Ludlow had submitted his plan, Congress appropriated $25,000 to begin the work. Before active operations had commenced, however, Colonel Ludlow was relieved by General Weitzel, and the latter having been directed "to make additional borings and examinations which might be necessary to more definitely locate the proposed ice harbor," the two following seasons were consumed in maturing a somewhat modified plan which was presented as the result of these investigations.* General Weitzel having died in the meantime, Major Heuer took charge of the district, and under his direction the modifications were completed. The drawing shows that the general character of the structure as originally proposed has been maintained, only the location and the outline of the harbor having been changed. Borings made at the intersection of the two ranges above mentioned at the site first considered the best had disclosed a very soft, muddy bottom of apparently unlimited depth. A penetration of 92½ ft.—the limit of the boring plant—below mean low water level was obtained and when the 4-in. tubing was being withdrawn, the frictional resistance upon its surface did not exceed 30 lbs. per sq. ft. as determined by computation.

Further investigations and considerations resulted in the adoption of the site marked D on the chart, about 1½ miles above Liston's Point, where a substratum of hard bottom was found, where the depth of water was the best available within this section, and where the harbor would be nearer the shore and yet no further from the main channel. The plan of the harbor was changed from that of a rhomb to that of a half ellipse, the minor axis of which, 2,000 ft. long, forms a base toward the shore, the length along the major axis being 2,400 ft. At the base the harbor is open, but protected by clusters of fender piles 50 ft. apart. On the up and down-river side the inclosing works are formed by iron barriers following the circumference of the ellipse, leaving an opening of 300 ft. for an entrance on the channel side, the whole inclosure containing an area of 56 acres, 20 acres of which have a depth of 24 ft. and over, the remaining portion gradually shoaling to 5 ft. toward the shore. The average rise and fall of the tide in this locality is 6 ft.

It will be observed by referring to the drawing which represents a section of the inclosing works near the outer end where the deepest penetration is required to reach the hard gravel substratum, and therefore is best adapted to illustrate the maximum dimensions in the constructive details, that it was decided not to trust for a foundation to the superincumbent mud alone, into which the screw piles were to be inserted, but that a series of piers was also introduced which forms an inherent part of the barriers and extends in every case to hard bottom. These piers are 92 ft. apart, center to center, and consist of six hollow cast iron columns rigidly braced together in the shape of a six-sided truncated pyramid. From the shore, where they are put together, they are floated into position with pontoons. The lower end of each column widens out, assuming the form of a large disk, to give a large bearing surface; in addition, solid screw piles projecting through the same end with a false shaft are turned into the hard bottom below after the pier has been properly placed. The interior of the columns are then to be entirely filled with cement concrete. That portion of the barriers between these piers is simply a narrow bridge or gangway 8 ft. wide resting upon six cross-rows of solid wrought iron screw piles, two piles in each row, which, from the shore outwardly, are screwed into the hard bottom below until the overlying mud stratum reaches a depth of 12 ft., then those further out remain at this depth in the mud and are provided with screws of a much larger diameter.

It is not intended to give more than an outline of the plan, as a full description of the details can be found elsewhere,* but it needs to be mentioned that the fender system provided for the exterior sides of the barriers is nothing more than an iron grillage made of four horizontal I-beams, which are crossed vertically by old rails, placed 3 ft. apart; the whole put together beforehand in panels and attached to the sides with suitable fastenings. The estimated cost of the ice harbor, as modified, is $308,800, or $5,514.28 per acre of protected area. To make an ice harbor of the same extent under the old plan, with isolated stone piers as ice breakers placed the same distance apart as the iron piers above described, would cost, according to prevailing prices, the sum of $777,000.

It is to be regretted that about the same year that the design for this ice harbor was perfected under Major Heuer, the inauguration of a very elaborate and costly plan for a general improvement of the Delaware River, recommended by a Board of Engineers, of which Colonel Craighill was the Chairman, interfered with and delayed the construction of the harbor. These new and more comprehensive projects have, for the time being, obscured the minor needs of the river, but the unusually long grip of formidable ice packs in which the port of Philadelphia has been held during the past winter, and the uninterrupted embargo thus laid upon the shipping interests for nearly two months, have emphasized their importance.

In considering the resistance which structures of the kind above described must be able to offer to floating ice in order to either fracture or crush it, or to retain their own stability, it has been noted that opinions upon this point vary materially. In the first place, but few experiments have been made as to the resistance of ice under compression; probably none as elaborate as Colonel Ludlow's,

* "Report of Chief of Engineers, U. S. Army, 1879," p. 1361, et seq.

* For description and details see Nos. 72 and 73, "Scientific American Supplement."

** Report of Chief of Engineers, U. S. Army, 1872; p. 783, et seq.

* Report Chief of Engineers, U. S. Army, 1884; p. 817, et seq.

* Report Chief of Engineers, U. S. Army, 1885; pp. 841-845.

made for want of data when designing the above ice harbor. His experiments made at that time were tabulated* and were to be continued. They showed, however, so far as they extended, that there is probably no material which is characterized by such variance in resistance to compression as ice. In so subtle a substance the structural or molecular cohesion is easily affected under the combined action and continual changes of temperature of air and water. The experiments also point to the necessity of adopting values for the crushing strength of ice twice as large as those previously known; in other words, to an increase from a mean of 200 to one of 400 lbs. for ordinary river ice. Prof. J. Phillips, of Oxford, fixes, by experiments, the superior limit for the modulus of cohesion of ice under compression at about 1,200 ft.; that is, that a "squeeze" cannot be propagated through ice, to an obstacle beyond, for a greater distance than 1,200 ft.; at any greater distance the ice itself crushes, and the residual force is expended in breaking it up. If the force be impulsive, the impulse cannot be transmitted even so far, perhaps not more than half that distance. From these experiments of Professor Phillips Mr. Mallet, M. Inst. C. E., deduces the equation of the greatest possible effect, U, of an ice field over 1,200 ft. long, long b wide, and d thick, $U = \frac{1}{2}\frac{W}{g} V_1^2 = \frac{(1{,}200 \times b \times d)\,62.4}{64.4} V_1^2$; the velocity V_1 being that which icefield acquired at the moment of impact. This formula has been used in computing the dimension of the ice barriers which constitute the modified project for the ice harbor at the head of Delaware Bay. I would refer the reader interested in this subject to the paper of Mr. Mallet as one of the best expositions ever written on this and related questions.*

From all that I have been able to gather, through the discussions of others and by personal observations, it is clear to me that in exposing open works like screw pile structures to floating ice, the effects are generally much less destructive than might be anticipated. Undoubtedly the comparatively small space occupied by the different members and their inherent elasticity have a great deal to do with that, provided that in the first place the disposition of the material has been restricted in size and the number of pieces to the smallest limit. The many landing piers, lighthouses, jetties, bridges, and even bulkheads and wharves, that have been erected of late years upon screw piles in rivers and bays and at the mouths of canals, some in the coldest climates, have proved in point of economy, rapidity of construction, and light appearance, to be far ahead of the cyclopean structures erected for the same purpose in the past.

* Report of Chief of Engineers, U. S. Army, 1881; pp. 788-790.
* The "Engineer," London, 1866; pp. 318-329.

A NATURAL RAILWAY TUNNEL.

By Emile Low, M. Am. Soc. C. E.

America is generally acknowledged to be the proud possessor of many interesting natural wonders, and of these the Natural Tunnel in Scott Co., Va., through which the line of the South Atlantic & Ohio R. R. runs, deserves to be ranked as one of the most important and interesting. While the so-called Natural Bridge in another part of the state is widely known through numerous descriptions and illustrations, but few people are acquainted with the existence even of the Natural Tunnel. The reason of this is quite obvious when the comparative interest of the two from a scenic point of view is considered. The Natural Bridge well deserves its appellation, for viewed either down or up stream it will be seen to be a veritable arch of stone thrown across the valley, and standing out in bold and defiant relief from the surrounding country. The Natural Tunnel, on the other hand, from the formation of the surrounding country, seems to partake more of the nature of "a hole in the ground." The cliff which guards its northern portal or entrance can be seen for a considerable distance when traveling down the valley, but the southern end or outlet is much more obscured and can only be seen after turning a large promontory, which is only a few hundred feet distant from it.

The Natural Tunnel can be reached very readily by means of the South Atlantic & Ohio R. R., a line running between Bristol, Tenn., and Virginia, where it connects with the Norfolk & Western and East Tennessee, Virginia & Georgia railways, and Big Stone Gap, Va., where connection is made with the Louisville & Nashville R. R. The length of the railway between these points is 66 miles.

The Natural Tunnel, which this railroad utilizes as part of its line, is situated about 21 miles from Big Stone Gap and 45 miles from Bristol. The waters of Stock Creek flow through the tunnel, and empty into Clinch River about two miles south of the tunnel, at a place called Clinchport, where the railway crosses the river.

Stock Creek is a mountain stream of considerable size, its total length being probably not less than 10 to 12 miles. It has its rise on the south side of Powell Mountain, its source being about 3,000 ft. or more above tide. Its general direction is nearly due south. The elevation of its water surface at its junction with the Clinch River is about 1,300 ft. It is about 75 ft. higher at the Natural Tunnel. These figures are only to be considered as approximately correct. In the neighborhood of the Natural Tunnel the creek is skirted by steep, precipitous hillsides forming quite a deep, narrow valley. Approaching the Natural Tunnel from the north, and when within a short distance from it, the casual observer sees to the right or west a depression which would indicate to him the continuance of the valley in which he is traveling. As he comes closer he becomes aware of his mistake, and notices that this depression is merely a small valley, tributary to the larger one. Coming closer he observes that the hillside on the left, or east, is becoming steeper and more precipitous, until it forms a perpendicular rock wall about 300 ft. in height. Suddenly this rock wall bears to the right, completely obstructing the valley and affording no apparent outlet to the swiftly flowing stream. The ground to the right of this precipice gradually descends toward the small valley mentioned above, forming generally slopes of easy descent.

An inspection of the accompanying sketch map, Fig. 1, will show the situation more plainly. This map is not from actual surveys, but is made up from observations taken on the ground by the author during a visit to the Natural Tunnel in March 24, 1893. It seems probable that this small valley was at a distant time the original bed of Stock Creek. The summit of this valley is probably 125

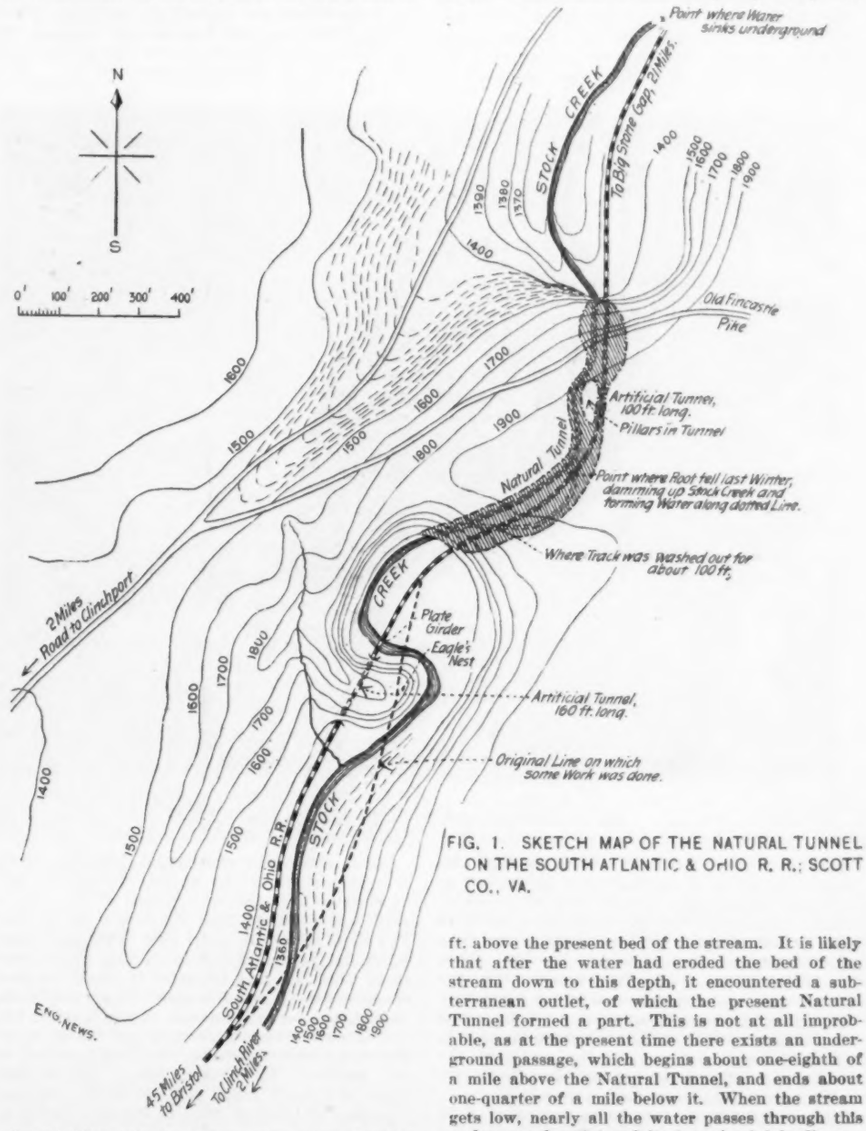


FIG. 1. SKETCH MAP OF THE NATURAL TUNNEL ON THE SOUTH ATLANTIC & OHIO R. R.; SCOTT CO., VA.

ft. above the present bed of the stream. It is likely that after the water had eroded the bed of the stream down to this depth, it encountered a subterranean outlet, of which the present Natural Tunnel formed a part. This is not at all improbable, as at the present time there exists an underground passage, which begins about one-eighth of a mile above the Natural Tunnel, and ends about one-quarter of a mile below it. When the stream gets low, nearly all the water passes through this underground outlet and its issue is plainly discernible below the tunnel at several different points. One outlet is in the bed of the stream, where it bubbles up like a miniature geyser. The entrance or north portal of the tunnel measures perhaps 50 ft. in width, and the height at the center is about the same. This entrance is particularly well shown by Fig. 2, reproduced from a photograph. The laminations, or stratification, of the limestone rock is plainly seen in the illustration. Those of the rock at the creek level are nearly horizontal, dipping slightly from west to east, while those of roof are much more inclined, and in the opposite direction.

After entering the tunnel it gradually enlarges, attaining perhaps its greatest width of about 100 ft. at about 100 ft. from the portal. This portion

of the tunnel is merely a large cavern or cave of the width described and about 200 ft. in length, and is shaped like a crescent with the ends cut off. The form of the roof is vault-shaped, its outlines being generally graceful curves.

This cave bends to the right, gradually decreasing in size, until it is not more than about 40 ft. wide and 30 ft. high. It preserves these dimensions for about 100 ft., bearing at the same time to the left, when it again increases in size to approximately the dimensions, as to width and height, of the cavern before noted. The tunnel again changes its direction, bearing to the right, forming what is known in engineering parlance a reverse curve, or in other words rudely resembling the shape of a letter S. The lower end of the tunnel is about 550 ft. long, making the total length some 850 ft. in all.

The original course of the water through the tunnel, before the advent of the railway, was first along the righthand side, then, after flowing through the narrow neck connecting the two caves, it followed along the left side to near the mouth of the tunnel, where it crossed over to the right side again, flowing in a graceful curve to the left at the base of the perpendicular rock walls, which form the exit of the tunnel. These walls, which in plan form almost a perfect rotunda, rise to a sheer, vertical height of nearly 300 ft. From the edge or top of these rocky walls the ground rises quite steeply toward the ridge over the tunnel, this ridge being possibly 150 ft. higher than the tops of the cliffs, overlooking the mouth. The high crags just opposite the mouth of the tunnel, and forming the southern wall of the rotunda, are know as the Eagle's Nest.

Referring again to the sketch map, Fig. 1, it will be seen that in order to utilize the tunnel for railway purposes it was necessary to drive a short tunnel through the spur intervening between the two caverns or grottoes. This tunnel is about 100 ft. long and was driven close to the eastern, or left-hand side. The track of the railway through the Natural Tunnel is generally from 12 to 15 ft. above the original surface. The floor of the artificial tunnel is necessarily of the same elevation. On account of this construction, a large pillar measuring 100 ft. in length and from 25 ft. to 30 ft. in width or thickness, stands near the upper end of the tunnel. The removal of this pillar would greatly enhance the grandeur of this natural curiosity.

A short time ago a large mass of rock became detached from the roof, near the middle of the tunnel, completely blocking the waterway. Not long after this fall there was a heavy rain which greatly swelled the water in Stock Creek. Owing to the obstruction the water was dammed up and forced into the channel shown in dotted lines in the sketch map. At the point marked the track was washed out for a distance of 50 ft. or more. It was replaced on a crib of ties, and the fallen material is now being removed as fast as possible.

Just south of the mouth of the Natural Tunnel there is an artificial tunnel, pierced through the point which forms one side of the rotunda like entrance, and mentioned above as the Eagle's Nest. This artificial tunnel is about 160 ft. long. The original location obviated this tunnel by merely cutting off the toe of the cliff. Considerable work was done at this point which, of course, destroyed to some extent the natural beauty of the place. Some work was also done on the opposite side of the stream. This abandoned line is shown by a dotted line on the sketch map.

FIG. 2. NORTH PORTAL OF NATURAL TUNNEL.

Fig. 3, also from a photograph, shows the mouth or southern end of the Natural Tunnel. It will be observed that the stratification of the rock is very clearly defined from the bottom to the top. The dip is slightly from the west to the east. The bridge in the foreground is an iron girder over Stock Creek. It may be stated in conclusion that the tunnel was a noted "corner" for several tracts of land, the surveys for each of which called for its inclusion. This made it extremely difficult to establish its exact ownership. In 1880, however, it was purchased by Messrs. James, Fowler and Jones, of Bristol, Tenn., and sold to the Virginia, Tennessee & Carolina Steel & Iron Co., which is its present owner.

IRRIGATION IN THE SOUTH.

Probably but few of our readers, aside from those who live in the southern states, are aware that irrigation is practiced in the south, especially in the rice growing sections and for orange culture in Florida.

The "Florida Agriculturalist," published at De Land, Fla., strongly urges the irrigation of orange groves and is also of the opinion that with plenty of water, supplied by irrigation, the crops of the state could be diversified. It thinks that the drought of the spring of 1892, which was pretty general throughout the entire orange region of Florida, convinced many growers that irrigation would result in the raising of more and better oranges.

Mr. S. F. Keeley, of Sanford, Fla., wrote us some months ago that "every orange grower is obliged to admit that an irrigating plant is a necessity." Mr. Keeley wrote further as follows:

"Groves around us are looking bad while ours are of good healthy color and growing finely. We fertilize with linseed meal, which is a genuine plant food. Water and linseed will make any grove show results."

Steam pumping plants for irrigation are quite numerous in certain parts of Louisiana, it being reported that within a radius of 15 miles of the town of Lake Arthur there were in 1892 as many as 35 steam pumps used for this purpose, irrigating about 10,000 acres of rice.

In the report of the Board of State Engineers of Louisiana for the two years ending April 20, 1892, reference is made to the danger to levees threatened by the passage through them of flumes and pipes for the irrigation of rice and the successful substitution of siphons by some planters.

Experiments with irrigation at the Sugar Experiment Station, Andubon Park, New Orleans, La., were made in 1891, and are described in Station Bulletin No. 14, Second Series, published in 1892. Mr. Wm. C. Stubbs is director of the station.

The average yield of sugar cane per acre with irrigation is reported as 34 tons, against only 7.89 tons without irrigation, but this difference was partly due to other causes than the artificial application of water.

In a paper entitled "Irrigation—the Needed Factor for Future Successful Agriculture," read in 1892 before the State Agricultural Society of Louisiana, Mr. Stubbs stated that in addition to sugar cane, there were irrigated with good results cotton, cow peas, sorghum and corn; six acres of corn having been forced by irrigation into early roasting ears and sold to Italians for nearly $500, while of ripe corn a yield of 100 bu. per acre was obtained from the irrigated and 25 bu. from the unirrigated crop.

In the paper mentioned above Mr. Stubbs expressed his belief that in the future "every plantation or farm, wherever situated, will be provided with irrigation appliances and used whenever the crop is in need of water."

Mention has been made of only such facts regarding irrigation in the south as have recently come to our attention. Doubtless many further instances could be cited; we should be pleased to have such brought to our attention and to receive reports and papers bearing on the subject, which is certainly growing in interest, importance and extent of practice.

COST OF AKRON PIPE SEWERS AT SOMERVILLE, MASS.

The accompanying table showing the cost of Akron pipe sewers built at Somerville, Mass., in 1891, is compiled from the annual report of Mr. Horace L. Eaton, City Engineer, for that year and from additional information sent by Mr. Eaton. The work was all done by contract. The table has been rearranged by size of pipe and average depth of cut in order to facilitate comparison:

Cost of Pipe Sewers at Somerville, Mass.

Sizes, ins.	Aver'ge cut, ft.	Length, ft.	Man-holes.	Chim-nies.	Av. cost per ft., $. Inlets.	Labor.*	Total.
12	9.0 S	466	1	..	28	..	1.10
12	9.0 S	207	1	..	10	.48	1.20
12	8.8 S	351	1	..	12	.48	.92
12	1.2	233	1	..	9	.45	.94
12	8.0	339	1	..	18	.40	.98
12	7.3	605	2	..	42	.50	1.13
12	7.3	303	1	..	16	.58	1.40
12	5.6 S	239	1	..	9	..	.98
10	9.2	171	..	1	8	.40	.78
10	8.7	653	2	..	40	.48	1.72 †
10	8.4	238	1	..	16	.40	1.39
10	6.0	199	1	..	12	.38	1.01
8	9.4	167	..	1	9	.50	.80
8	8.6	162	..	..	6	.50	.75
8	8.2	205	1	..	10	.43	.88
8	8.0 S	242	..	..	9	.48	.80
8	7.8	240	1	..	12	.34	.73
8	7.3	167	..	1	6	.38	.59
8	7.2	202	1	..	10	.35	.78
8	7.0 S	118	..	..	6	.32	.57
8	6.9	251	2	..	20	.37	1.15
8	6.4	207	1	..	12	.33	.78
8	3.5	164	1	..	6	.13	.57

S = sand; all other material was a clayey hardpan.
* Including trenching, pipelaying and backfilling only.
† 169 cu. yds. of rock at $3 per cu. yd.

STRENGTH OF CONCRETE SLABS.*

This paper gives the results of a series of tests made by the author to determine the strength of cement concrete slabs made with varying proportions of cement, in order to ascertain their suitability for covering an underground trench exposed to ordinary road traffic. The slabs were made with Portland cement and ground clinker obtained from furnaces which burned ashpit refuse.

The composition of the cement used was:

	Per cent.		Per cent.
Volatile matter.....	0.50		
Silica.—Insoluble, 4.60; soluble, 17.10.	21.70	Lime.	58.20
		Magnesia.	1.44
Alumina.	11.15	Sulphuric acid.....	1.30
Oxide of iron.....	4.85	Alkalies.	0.85

Its weight, when filled into a measure from a hopper with a fall of 1½ ft., was 112 lbs. per struck bushel. Its fineness was such that when sifted through a sieve having 2,500 meshes to the square inch, the residue was 12.8%. Its tensile strength was tested, in a Bailey shot machine, on briquettes of a sectional area of 1 sq. in., the stress being applied at a rate of 100 lbs. in 22½ seconds. The briquettes were placed in water 24 hours after being gaged; and, when tested after seven days' immersion, exhibited a tensile strength (as an average of seven tests), of 605 lbs. per sq. in. The clinker was broken by being crushed once in a mortar-mill with two rollers, and was then passed through a screen having ¾-in. meshes, and was thoroughly washed with clean water. This washing requires to be carefully done, as otherwise it was found that the concrete swelled and blew after setting. The materials were mixed in varying proportions, three sets of slabs being made: one set with 4½ parts of clinker to 1 of cement; one set with 6 parts of clinker to 1 of cement; and one set with 8 parts of clinker of 1 cement. In those made with 4½ parts to 1 it was found that there was sufficient fine material to properly fill the interstices, though it was not so in those made with 6 parts to 1. When 8 parts of clinker to 1 of cement were used, the clinker was made up of 6 parts broken to pass ¾-in. mesh, and 2 parts ground to the fineness of coarse sand—the clinker being, if anything, rather in excess. The concrete was then filled into wooden molds and well rammed. The molds were greased at the joints to prevent leakage; and the bottom was sanded and the sides and ends were greased to prevent the concrete from adhering to them. As soon as the concrete was set, the wedges were knocked out and the sides and ends were removed.

The slabs thus made were found to be all solid and practically homogeneous. Each set of slabs was made in three sizes: 1 ft. 9 ins. by 1 ft. 6 ins., by 4 ins.; 2 ft. 6 ins. by 1 ft. 6 ins. by 6 ins.; and 3 ft. 3 ins. by 1 ft. 6 ins. by 9 ins., respectively. These were kept dry—some for 14 and some for 21 days—and were then tested to destruction by means of hydraulic pressure, the pressure being applied by a hand-pump in about two minutes. The slabs were supported at each end by oak balks, faced with ¾-in. iron plates, strips of leather of the width of the bearings and 5-16 in. thick being placed between the iron plates and the slabs. The distance apart of the bearings varied, being so arranged that the smallest-sized pieces had a bearing at each end of 4½ ins., and the largest sizes 6 ins. The pressure was applied along the center line of each slab by a channel iron 6 ins. wide, with a packing strip of leather between the channel iron and the slab. With one exception, no sign of fracture appeared before they broke down. The plane of fracture was generally fairly through the middle of the slab.

The accompanying table gives the results of the tests, and the value of K, the coefficient of rupture, calculated from the following formulas:

Supports 12 ins. apart, load on center 6 ins. of slab

$$K = \frac{3\,L\,W}{16\,B\,D^2};$$

Supports 18 ins. apart, load on center 6 ins. of slab

$$K = \frac{5\,L\,W}{24\,B\,D^2};$$

Supports 27 ins. apart, load on center 6 ins. of slab

$$K = \frac{2\,L\,W}{9\,B\,D^2};$$

where L = span, W = breaking weight in pounds, B = breadth and D = thickness of slab. The results obtained with the slabs made of 4½ parts of clinker to 1 of cement are fairly consistent; and the variations in the other tests is, in the author's opinion, due to the fact that in the 6 to 1 slabs there was too little, and in those made in the proportion of 8 to 1 too much fine material. A rectangular block of concrete 6¾ ins. by 3¼ ins. by 4 ins., cut from the outside of the broken part of block A, and tested for crushing resistance, broke down under a pressure of 1,120 lbs. per sq. in. The weight of this concrete, 4½ to 1, 15 days old, was 118 lbs. per cu. ft. The author is indebted to Prof. Henry Robinson, M. Inst. C. E., for permission to communicate the results of the foregoing tests.

It was subsequently decided to try the effect of crushed blast furnace slag instead of clinker, and one slab made from this slag broken to pass a ¾-in. mesh, without the addition of any fine material, in the proportion of 4½ of slag to 1 of cement, was tested by a dead weight, with the following result: Cement used, weight 120 lbs. per bushel; fineness, 7.8% residue left on a sieve having 2,500 meshes to the square inch; tensile strength, tested in the manner before described, 449 lbs. per sq. in.; slab, 3 ft. 3 ins. long by 2 ft. 5½ ins. wide by 4½ ins. thick, kept for 15 days in air; supports 27 ins. apart; load applied on center 6 ins. of slab—breaking weight, 2,518 lbs.; time taken in applying weight, half an hour; this gives K = 25.3 lbs. The coefficient is lower than that obtained with clinker slabs made in the same proportions; but this is due partly to the additional length of time taken in applying the load, and partly to the inferior strength of the cement used.

With the object of comparing the strength of the two kinds of slab under similar conditions, the following tests were made, the slabs being placed in position under conditions as nearly as possible those in which they were intended to be used: A slag slab, precisely similar to that last mentioned, was supported on two walls of concrete, 27 ins. apart, formed in a trench excavated in the ground, the slab being covered with 2 ft. of earth well rammed to the ground level. The weight was then applied on an area of 9 ins. by 6 ins., the larger dimension being in the direction of the breadth of the slab. The breaking weight was 11,865 lbs.; the slab broke across the center, and the time occupied in applying the load was one hour. Assuming that the pressure was distributed by the earth-filling uniformly over the whole surface of the slab, K = 67 lbs. A clinker slab, 3 ft. 3 ins. long by 2 ft. 2 ins. wide by 6¾ ins. thick, was made of 4½ parts of broken and washed clinker, without the addition of any fine material, and one part of the same Portland cement as that used in making the slag slabs; but when tested it was 35 days old, compared with 15 days in the case of the latter. This clinker slab was tested in the same trench and in the same way as the slag slab, and broke with a weight of 9,567 lbs., thus giving K = 27.2 lbs.; the time taken in applying the load was one hour.

These experiments showed that the slag slab 15 days old was 2.46 times as strong as the clinker slab 35 days old. The author considers that these latter tests are not completely comparable; but they could only be made as opportunity offered, at intervals during the prosecution of other work.

Results of Tests of Concrete Slabs.

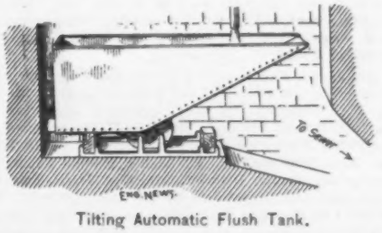
Slab.	Dimensions. Ft.	Ins.	Ft.	Ins.	Distance apart of supports. Ins.	Breaking weight. Lbs.	Coeff. of rupture = K. Lbs.	Averages. Lbs.	Proportions of concrete.	Number of days kept.
A	1	9	× 1	6 × 4	12	5,081	39.6			
B	2	6	× 1	6 × 6	18	5,986	34.6	35.4	4½ to 1	15
C	3	3	× 1	6 × 9	27	7,745	31.8			
D[1]	1	9	× 1	6 × 4	12	6,518	50.9			
E	2	6	× 1	6 × 6	18	9,946	57.5	52.1	4½ to 1	21
F	3	3	× 1	6 × 9	27	11,648	47.9			
G	1	9	× 1	6 × 4	12	2,755	21.5			
G'[1]	1	6	× 1	0 × 4	12	1,747	20.4			
H[2]	2	6	× 1	6 × 6	18	1,400	8.1			
H'[2]	2	6	× 1	6 × 6	18	1,098	6.3	22.9	6 to 1	14
I	3	3	× 1	6 × 9	27	4,939	20.3			
I'	3	3	× 1	6 × 9	27	7,282	29.9			
I''	3	3	× 1	6 × 9	27	5,466	22.5			
J[3]	1	9	× 1	6 × 4	12	1,322	10.3			
K	2	6	× 1	6 × 6	18	2,362	13.1	19.8	6 to 1	21
L	3	3	× 1	6 × 9	27	6,471	25.6			
M[4]	1	9	× 1	6 × 4	12	650	5.1	5.1	8 to 1	14
N	1	9	× 1	6 × 4	12	1,187	9.2			
O	2	6	× 1	6 × 6	18	730	4.2			
P	3	3	× 1	6 × 9	27	1,991	8.2	7.6	8 to 1	21
P'	3	3	× 1	6 × 9	27	2,105	8.7			

[1] Part of slab which broke in getting out of mold.
[2] Affected by frost. } Not included in averages.
[3] Broken in getting out of mold. }
[4] Not dry through.

FIG. 3. SOUTH PORTAL OF NATURAL TUNNEL.

THE TILTING AUTOMATIC FLUSH TANK.

A simple form of flush tank, clearly shown by the accompanying illustration, is in successful use, it is reported, at Alameda, Oakland and Stockton, Cal. The tank is of the tilting type, and discharges by the weight of the contained water when full. It may be fed by a faucet in the usual manner, and has a capacity of about 50 gallons, which, of course, could be increased, doubtless with advantage. There are over 100 of these tanks in use at Alameda, where they are placed just beneath the sidewalk. For use in colder climates it is evident that the tanks would have to be placed deeper. A small size of tank is made for use in connection with house sewers, and it is suggested that several houses could sometimes be connected to one of these tanks, and thus sewage instead of water be used for flushing.



Tilting Automatic Flush Tank.

The tank is manufactured by the Gravity Flusher Co., 723 Market St., San Francisco. We are indebted to Mr. Walter C. Stevens, C. E., of Melrose, Mass., for the above information. Mr. Stevens is agent for the tank in Massachusetts.

* By Sidney Richard Lowcock, Assoc. M. Inst. C. E., From Selected Papers of the Institution of Civil Engineers.

PERSONALS.

Mr. John G. Zane has been elected City Engineer of Escanaba, Mich.

Mr. Charles F. Kohlmann, City Engineer of Racine, Wis., died April 24.

Mr. Lee L. Dagron has removed his office to 533 Rookery Building, Chicago.

Mr. W. B. Howe has been appointed City Engineer of Concord, N. H., which office was recently created, March 23, 1893.

Mr. F. W. Rogers has been reappointed City Engineer of Port Huron, Mich. Mr. Thomas Danger is the new Superintendent of Public Works.

Mr. F. A. Dunham, of Plainfield, N. J., has opened a branch office at Pittsburg, and will act as engineer for paving, sewer and other municipal work.

Prof. W. S. Yates, of the Department of Minerals and Economic Geology in the National Museum, at Washington, has been appointed State Geologist of Georgia.

Mr. E. P. Lord, Superintendent of Motive Power of the Cleveland Cincinnati, Chicago & St. Louis Ry., has accepted the position of Manager of Construction with the H. K. Porter Co., builder of light locomotives, Pittsburg, Pa.

Mr. A. A. Robinson, formerly Vice-President and General Manager of the Atchison, Topeka & Santa Fe R. R., has been elected President of the Mexican Central Ry., vice Mr. S. W. Reynolds, who is now Chairman of the company.

Mr. C. F. W. Felt, who has been appointed Division Engineer on the Northern Division of the Gulf, Colorado & Santa Fe Ry., as noted in our issue of April 20, has his office at Cleburne, Tex. The appointment was made in February.

Mr. G. E. Beach has opened an office at Dallas, Tex., as a civil engineer, and will undertake the making of plans, specifications and drawings and superintending the construction of water-works, gas works, ice plants, etc., as well as to improving and extending existing plants.

Mr. M. T. Daly has been reappointed Commissioner of Public Works of New York city; Dr. Cyrus Edson has been reappointed Health Commissioner, and Mr. L. F. Haffen has been appointed Commissioner of Street Improvements of the 23d and 24th Wards, vice the late Mr. Louis J. Heintz.

Mr. Augustus Knudsen, C. E., Mem. Tech. Soc. P. C., has closed his office in San Francisco, Cal., and moved to New York, where he expects to locate. He was chief engineer of government railways in Chile under Balmaceda's administration and came to the United States shortly after the latter's downfall. He has recently published a work on "Triangular Surveys from Single Stations."

Mr. Jas. A. Case has resigned his position as Assistant Statistician of the Interstate Commerce Commission, to engage in a private law practice, his resignation taking effect April 30. His resignation is a real loss to that department of the commission's work and to the public, as he has done much to organize and perfect the commission's statistical work, which has given much information never before existing and which has shown a steady tendency to improve. His present address is 17 Chauncey St., Cambridge, Mass.

Messrs. Rudolph Hering, of New York, and B. M. Harrod and H. B. Richardson, of New Orleans, have been appointed by the Mayor a board of engineers to pass upon the plans for an improved system of drainage for the city of New Orleans, as submitted by the City Engineer. The statement lately made in these columns that Col. Geo. E. Waring, Jr., was a member of this board, or appointed consulting engineer to the city, was an error, due to an unauthorized item to that effect in a New Orleans paper.

Mr. James Buckelew has been appointed Supervisor of the Trenton cut-off of the Pennsylvania R. R. Mr. E. E. Lippencott has been appointed Supervisor at Osceola, Tyrone Division. Mr. Geo. H. Brown has been appointed Supervisor at Phillipsburg, Tyrone Division. Mr. A. J. Whitney, Jr., has been appointed Supervisor at Tyrone, Tyrone Division. Mr. Geo. H. Neilson has been appointed Supervisor of the Altoona yard. Mr. Frank Ellmaker has been appointed Superintendent of the Middle Division, vice Mr. E. McClellan, resigned. Mr. R. M. Patterson has been appointed Superintendent of the Frankfort & Delaware Extension, vice Mr. Frank Ellmaker.

Mr. Thomas W. Davis, ex-City Surveyor of Boston, Mass., died April 22, of pneumonia. He had held the position of City Surveyor from 1868, when the office was established, up to a year ago, when he declined to be reappointed. Prior to his appointment he was Assistant City Engineer under Mr. Crafts. Mr. Davis was born in Templeton, Mass. Previous to entering the City Engineer's office, he passed one term at the Rensselaer Polytechnic Institute, Troy, N. Y., and one term at the Lawrence Scientific School, at Cambridge, Mass. He entered the City Engineer's office in 1851 under Mr. Chesbrough, then City Engineer. In the autumn of 1853 he was transitman on a preliminary survey of the Merrimac & Connecticut River Railroad in New Hampshire, and in 1854 he was resident engineer on location and construction of the Boston & New York Central R. R., now the New York & New England R. R. He was absent from Boston in the summer of 1856 on a survey of the extension of the water-works of St. John, N. B. From 1863 to 1866 he was Assistant City Engineer, and in 1868 was made City Surveyor, which position he held until Aug. 6, 1892. He was a member of the Boston Society of Civil Engineers.

NEW PUBLICATIONS.

MAY MAGAZINES.—There is probably no state in the Union which will receive greater benefits from the Nicaragua Canal than California, and we believe the papers of the state are a unit in urging government aid to that enterprise. A brief paper advocating this is found in this month's "Californian," which also contains a paper which will interest engineers who have spent some time in Mexico illustrating scenes on the Viga Canal. Two other finely illustrated papers deserving mention are "Summer Days in Kashmir" and "The Lost Races of Arizona." The "Nineteenth Century" contains one of Prince Kropotkin's excellent descriptions of recent scientific discoveries. Describing recent advances in meteorology, he warmly praises the theory of atmospheric circulation advanced by an American scientist, the late Wm. Ferrel, and says his views are sure for some years to come to be the leading theory of meteorology. "They have already given a strong impulse to theoretical research, and have created a whole literature in Austria and Germany." The same magazine contains an exceedingly interesting discussion of England's position in Egypt, in which we note the interesting statement that the work done by English engineers in developing the irrigating facilities of that country is about the only good which has resulted to Egypt from the British occupation. The Behring Sea question is explained very clearly in a brief article which concedes that an international agreement ought to be entered into for the preservation of the fur seal from extinction, but denies that the United States has any authority over Behring Sea outside the three-mile limit.

We believe it is not generally known that a few months ago the French Academy awarded the Cuvier medal to the United States Geological Survey, accompanying the award by a review of the work which has been done by American geologists. A translation of this trubute to American scientists appears in the "Popular Science Monthly." Other papers deserving mention in the same magazine are "Evidences of Glacial Man in Ohio," and "Growth of Our Knowledge of the Deep Sea." In "Scribner's," Walter Besant begins an odd story, which is supposed to be written near the close of the twentieth century, and which describes the social progress which the next 100 years are expected to bring forth. The author begins by saying that "The Conquest of the Professions by the People was the event which did most to bring about the social revolution, which was the event of the first part of the twentieth century." He then proceeds to tell how in the nineteenth century the professions were so hedged about and guarded that admission could only be obtained by young men of gentle birth and good breeding, whose parents could spend at least $5,000 on their education. Mr. Besant writes of conditions in England which do not obtain in America; but those who favor hedging about the engineering profession in this country with various restrictions will do well to read Mr. Besant's story and consider the question from his point of view. In "Harper's," Julian Ralph resumes his descriptions of Western life, and writes on the city of Denver and the state of Colorado—an excellent paper, filled with practical facts, which are evidently the result of keen observation. He gives an extended description of the progress of irrigation in Colorado, but holds that the manner in which it is being effected—the prizes being reaped by the great irrigation corporations, while a heavy and perpetual tax is laid on the cultivators of the soil—will lead eventually to great public dissatisfaction, and extended litigation and legislation.

Thos. A. Janvier's account of "The Evolution of New York" will interest every New Yorker, and the papers on the World's Fair, with their fine illustrations in "Harper's," "Scribner's" and "The Century" are all deserving of much praise. The last named magazine has also an article by Gilbert Gaul on "Nicaragua," describing the people and the scenery, however, rather than the things which are of special interest to engineers. "The Journal of Geology" is a new "semi-quarterly," edited by the geological faculty of the University of Chicago. The February-March number contains a fine geological map of the Lake Superior region, accompanied by a sketch of its geologic history.

The United States side of the Behring Sea dispute is given by Benj. F. Tracy, ex-Secretary of the Navy, in the "North American Review," and he certainly makes a much stronger argument than that in the English review, noted above. Mr. H. P. Robinson, of the "Railway Age," tells of "A Railway Party in Politics," a title which refers to the action of the railway employees in Minnesota, Iowa, Nebraska and some other states, in opposing the candidates for office who were known to favor anti-railway legislation. Grand-Master Sargent, of the Brotherhood of Locomotive Firemen, discusses the Ann Arbor strike from the employees' point of view. What that point of view is, his closing sentence will indicate: "If, finally, the court's decision is sustained, I do not doubt that action will be taken to regain the liberties which the court has trampled upon."

ALTERNATING CURRENTS OF ELECTRICITY: Their Generation, Measurement, Distribution and Application. By Gisbert Kapp, C. E., M. Inst. C. E., M. Inst. Elec.; with an introduction by Wm. Stanley, Jr. New York: The W. J. Johnston Co., Ltd. 12mo; cloth; pp. 166; 37 illustrations; 2 plates; $1.

This is a reprint of a series of lectures delivered by the author before the Institute of Royal Engineers. It is not, and does not pretend to be, an exhaustive discussion of this subject, but is an attempt to make plain to the engineer unfamiliar with electrical matters the general nature of alternating currents and the practical problems involved in their utilization. Mathematical discussion is avoided so far as possible, and the book will be found interesting and intelligible by the ordinary engineer.

THE DRAINAGE AND WATER SUPPLY OF CHICAGO: By D. W. Jackson. 8vo; pp. 138; illustrations. Chicago: Rand, McNally & Co. Price, 35 cts.

This is a discussion, written last year by a retired lawyer, of the great drainage scheme, then scarcely more than projected, but now being carried out, to protect the water supply of Chicago through the agency of a canal connecting the Chicago River with the Illinois River. The author is opposed to the scheme, and seems to favor instead the continued use of the present Bridgeport pumping station, with enlargements if necessary, and the purification of the sewage of a large section of the city, including that from the stock yards, by chemical precipitation.

As would be expected from a person without a knowledge of engineering, the author presents some rather confused ideas, which need not be commented on here.

HEALTH IN COUNTRY HOMES: The Disposal of Sewage. A Series of Articles Reprinted from the New York "Evening Post." 8vo; pp. 8. New York: The "Evening Post" Publishing Co. Price, 5 cts.

This little pamphlet describes how one engineer, or firm of engineers, solves the question of the disposal of sewage from country houses by surface or subsurface irrigation—the sewage being collected in a tank and discharged by means of a siphon upon or underneath alternate tracts of land. The subject deserves the attention of all owners of country houses, or, in fact, of houses located where there is no sewerage system; but a fair sized area of land is necessary for the model of disposal described.

MINERAL RESOURCES OF THE UNITED STATES: Calendar Year, 1892. By David T. Day, Chief of Division of Mining Statistics and Technology, U. S. Geological Survey, Washington, D. C.: Government Printing Office. 8vo; 630 pp.

This eighth edition of the series deals with the mineral progress in the United States for the year 1891, though some of the data contained therein extends far into 1892, and it covers the same range of subjects treated of in the previous reports. The totals in each case have already been published in a separate form, as well as many of the chapters on the production of the chief minerals.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on May 3, a paper by H. D. Whitcomb, on "The Improvement of the James River, Virginia," was read. This paper is supplementary to a paper by Colonel Craighill, published in the "Transactions" of the Society in 1888, and gives the results obtained by the work thus far accomplished. The following is an abstract of the paper:

The James is formed by the joining of the Jackson and Cowpasture, and from the junction to tide-water at Richmond it is 234½ miles long and falls 4.34 ft. to the mile. The last ten miles of this part of its course are over granite. The James drains 7,000 sq. miles above Richmond, and a total of 10,500 sq. miles at Hampton Roads. It was carefully gaged in 1877, when its flow was the smallest known, and the flow was then 1,332 cu. ft. per second. In great freshets the flow reaches 300,000 cu. ft. In the great freshet of November, 1877, the rise at Richmond was 28.6 ft. above mean low tide.

The fall below Richmond is small, the difference in level at low tide for 19 miles being about 0.3 ft., and for the 101 miles to Hampton Roads about 1 ft. The range of tide varies with the width of the river and fluvial discharge. At Newport News it is 2.3 ft.; at the mouth of the Chickahominy, 2.0 ft.; at City Point, 2.5 ft.; at Dutch Gap, 3.3 ft., and at Richmond, 3.6 ft. From Fort Monroe to Richmond the tidal wave travels about 13 miles per hour; and the average

velocity of the water at the swiftest period of the tide is about 2 ft. per second, or one-ninth that of the wave. The sectional area of the river increases from 6,331 sq. ft. at 3 miles below Richmond, to 305,777 at Rocklanding Shoal, 89 miles below.

For about three miles below the entrance to the Richmond dock the river-bed is in soft gneiss, with bowlders, strata of harder rock, and reefs of granite or gneiss. The sand, gravel and the smaller bowlders have been swept away as a consequence of the regulation works. At Richmond Bar hard rock is found at a depth of 16 ft., but it disappears ½ mile below. For 3 miles below this bar the bed is in sand, coarse gravel and some bowlders, and a bed of cobble is found at 18 ft. in a shoal 11 miles below the city. The depth is generally ample from Drewry Bluff, 7 miles below the city, to City Point, 25 miles down; but there are shoals where the current crosses from bank to bank, so that the depth is reduced by sand or mud to 18 ft., or 4 ft. less than is required by the present scheme. At City Point the river becomes an estuary. The banks of the river when more than 10 or 12 ft. above tide are often of black indurated clay, on which rests a sandy gravel covered with varying depths of yellow clay. The indurated clay forms a bed at the Dutch Gap, and at other points above. This clay is wearing away slowly where the current strikes it, and small areas are undermined and swept away.

The first appropriation made by Congress after the war was $50,000, in July, 1870. The city of Richmond expended in the five preceding years $70,000, and in 1871 the city appropriated a further sum of $250,000. In January, 1872, all obstructions had been removed, and the cut-offs opened to navigation with a depth sufficient for the largest vessels then trading to Richmond. After this date operations were carried on by the government and the city in conjunction. The project was to secure a depth of 18 ft. at full tide in a channel 180 ft. wide from the Richmond Dock to Harrison's Bar, 37½ miles below, with 18½ ft. in rock excavation. It was important to contract the river near Richmond no more than was sufficient for the project, and the plan of wing dams was adopted for regulating the width, with the expectation that their outer ends would eventually be connected by training walls. The scour from between the wing dams was deposited below, especially on a shoal between them and deep water at Drewry Bluff, and it soon became evident that regulation must be extended over this shoal at no distant day.

In July, 1884, Congress adopted the project of increasing the depth to 22 ft. at low tide from the sea to Richmond, with a width of 400 ft. from the sea to City Point; thence 300 ft. to Drewry Bluff, and 200 ft. thence to Richmond. This increase in depth of channel, which is 7 ft. near Richmond, is for three miles below Richmond in almost solid rock. The cost of the project was estimated at $3,800,000. The cut at Dutch Gap has been enlarged and deepened. Training walls have been constructed on the shoal at Kingsland Reach, and a channel dredged to the required depth. Dredging has been done between Richmond Bar and Drewry Bluff, and the old line of regulation changed for the new project and extended to deep water at the bluff. A contract was made in 1892 for increasing the depth the whole distance to the sea to 18 ft. throughout at low tide.

The wing dams and training walls are simple and inexpensive. The depth on the lines of the wing dams averages 11½ ft., and their cost is $3.47 per lin. ft. The retaining walls were built in an average depth of 10½ ft., and cost $2.50 per ft. The wing dams are of sheet piling, 3 ins. thick, driven from 1 to 10 ft. into the river-bed, supported by strong piles driven 8 ft. between centers, and braced by a second row driven 10 ft. lower down the stream. The upstream face of the sheet-piling is protected by mats of ordinary brush fastened with galvanized wire. These mats are 3 ft. thick and 10 ft. wide, project beyond the end of the dam, and are loaded with stone or gravel. The upper surface of the sheet-piling is at the level of mean high tide. The shore ends are protected with stone, and white oak piles driven at the outer end are left high enough for a mark in ordinary freshets, and also as a protection to the dam. The materials from excavation are dumped on the upper side and outer end, and the dam is protected in this way.

The training walls consist of two rows of piles 6 ft. apart, driven 8 ft. between centers, and filled with brush. The bottom layer is made of saplings fastened with wire, in sections 30 ft. long, placed at right angles to the current, projecting 15 ft. in front and 9 ft. in rear of the wall, and loaded with stone or gravel. Above this are packed tiers of brush crossways between the piles, which are left 4 ft. above low tide, and the piles are then bound together in both directions with No. 12 galvanized wire. As the wire settles, more filling is added until the dam finally becomes permanent. Some of the wing dams are 17 years old, and are as efficient as ever. None of the training walls have been injured by ice or currents.

In light material there is first a deep scour at the outer end of the wing dam, trending outward toward the channel, but becoming less as the section regains its original area. The training walls retain better the deposits of silt and dredged material between the wing dams, neutralize the effects of waves from high winds or passing steam vessels, and give a finish to the works of regulation. A deposit was forming under the flat bottoms of the monitors, located near City Point. An ice gorge formed here in 1879, the river raised to 18½ ft. above low tide, and a part of the discharge escaped through the marsh, but more or less passed under the ice and scoured off 4 or 5 ft. of the shoal for a considerable width. The actual rise in the river without the obstruction would have been 10 ft. The ice remained unbroken for several miles above the gorge for a week, and the shoal was not troublesome for several years afterward.

Four cut-offs have been considered, one of which, at Dutch Gap, has been made. The distance to be saved, if they are all built, is 9¼ miles in 17½ miles. The writer has not found by the records any perceptible increase in the slope below the Dutch Gap cut-off in consequence of the cut-off. This cut-off was begun during the civil war by the Federal forces, but not completed. In 1870 it was from 60 to 70 ft. wide, with from 7 to 12 ft. in depth, and, soon after the war, was closed by a causeway across the upper entrance. This was washed out by the freshet of 1870. The neck of land cut through is 40 ft. above tide, and requires a cut 250 ft. long at the top, and 640 ft. at 18 ft. below. The material is a hard clay, yielding with difficulty to dredging. The bed wears slowly under the current, and is 10 ft. higher than the river-bed just above. In 1877 the cut was enlarged 180 ft. in width and 15 ft. in depth; in 1880, to a width of 250 ft. and a depth of 18 ft., and in 1889, to 300 ft. throughout. It is now 550 ft. wide at its narrowest point, and the depth is to be made 25 ft. for a width of 100 ft.

Other improvements are in progress at various points. The depth available for navigation from Richmond to Hampton in 1870 ranged from 7 to 14.8 ft., while the depth now ranges from 13.8 to 17 ft., and vessels drawing 16 ft. were brought to the city limits in the past year at high tide. Since 1870 the United States has appropriated $1,532,500, of which about $200,000 remains unexpended, and the city of Richmond has expended $500,000 in addition. Most of the work has been done under the direction of Col. Wm. P. Craighill, U. S. Engineers, with the exception of two years, when Lt.-Col. P. C. Haynes, U. S. Engineers, was in charge. The work within the city limits is under the charge of Col. W. E. Cutshaw, City Engineer.

Members of the society who intend visiting the World's Columbian Exposition can, upon application to the secretary, secure a card which, upon presentation at the Engineering headquarters, 10 Van Buren St., Chicago, will entitle them to cards of admission to the reception rooms, and to the Engineering Congress, particulars of which were given in our issue of April 20.

ANNUAL CONVENTION OF STATE RAILROAD COMMISSIONERS.—The fifth annual convention of the Railroad Commissioners of the United States was held in the rooms of the Interstate Commerce Commission, at Washington, D. C., on April 19 and 20, delegates from 19 states being present. The convention was organized with Mr. Geo. M. Woodruff, of Connecticut, Chairman, and Mr. Edw. A. Moseley, Secretary of the Interstate Commerce Commission, Secretary.

The first subject taken up was the report of the committee on reasonable rates. The committee considered that owing to the conditions of the question an invariable standard of rates, just alike to the shipper and the railway, cannot be found, and that the nearest approach to it is "in some body or commission selected in the states on the model of the Interstate Commerce Commission, whose term of office shall run a number of years, the terms of office alternating, so that those of no two members expire at the same time. The long term would have the effect to relieve the incumbent from popular pressure, and the temptations to yield that necessarily surround an elective board. The alternating periods when these terms expire would always insure a majority of the commission familiar with the subject, and with a full knowledge of the difficulties in the way of the right adjustment of rates. Allow these bodies to patiently take up and adjust each individual case after an impartial hearing in the light of surrounding circumstances and conditions."

There was little discussion on this report, and the report on safety appliance legislation was next called for. As the legislation which this committee was appointed to urge had already been enacted (Eng. News, March 2, 1893), the discussion turned principally upon the advisability of recommending uniformity in connection with couplers, which it was decided not to be advisable to do. The report of the committee on uniformity of railway accounting was next read, and adopted, after which a paper on the importance of a statistical bureau in the solution of the railway problem was read by Mr. H. C. Adams, the Statistician of the Interstate Commerce Commission. The first day's business then closed with some general discussion.

On the second day, the first topic taken up was that of uniform classification. Commissioner Jas. W. McDill, of the Interstate Commerce Commission, discussed the question at some length, outlining the difficulties attending such a compilation, and which he considered so formidable as to raise in his mind a doubt whether an absolutely uniform system of classification was attainable. He did not doubt that many of the inequalities which existed under the present varied classification might be removed, and he believed an effort in that direction was desirable, but it was impossible, in his judgment, to make an absolutely iron-clad classification that would suit every case. Mr. McDill was followed by Commissioner Dey, of Iowa, who held that a uniform classification was not only desirable, but possible, and that the effort toward such a compilation must not be abandoned. Mr. Dey was followed by Mr. Duncan, of South Carolina, and others, all favoring a continued movement looking toward this end.

At the close of the discussion Mr. Dey offered the following resolutions, which were adopted:

Resolved, That we believe that still further advance toward uniform classification of freights will promote the welfare and convenience of shippers and of the railroad companies, and we commend a conservative but persistent effort to that end.

Resolved, That this convention recognizes the difficulties that stand in the way of the accomplishment of this purpose. It is believed that the end in view can only be attained by the exercise of federal authority, and we respectfully present the subject to the Interstate Commerce Commission as one worthy of their persistent and continued effort, to the end that a system of uniform classification of freights, applicable to every part of the United States, shall ultimately come to be an accomplished fact.

Following this action the other subjects enumerated in the call for the convention were taken up in order, but elicited no discussion. Several resolutions were then offered—by Mr. Teisburg, of Minnesota, on territorial assignment of statistics of operation; by Mr. Paddock, of Illinois, that a committee of five be appointed to consider the subject of abuses by the use of shippers' cars, to report to the next convention; by Mr. Dey, of Iowa, that a committee of five be appointed to consider the subject of pooling, and report to the next convention; and by Mr. Mills, of Minnesota, that a committee of like number be appointed to report on the uniform classification of freights; all of which were adopted. The convention adjourned after fixing the date of the next convention for the first Tuesday in May, 1894.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
May 5. Secy., E. K. Smoot, 926 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
May 5. Secy., O. Von Geldern, 719 Market St., San Francisco.

SWEDISH ENGINEERS' CLUB.
May 6. Secy., P. Valentine. At 281 Union St., Brooklyn, and 846 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.

ENGINEERS' CLUB OF PHILADELPHIA.
May 6. 1122 Girard St. Secy., L. F. Rondinella.

WISCONSIN POLYTECHNIC SOCIETY.
May 8. Secy., M. F. Schinke, City Hall.

ENGINEERS' CLUB OF KANSAS CITY.
May 8. Secy., Waterman Stone, Baird Building.

ATLANTA SOCIETY OF CIVIL ENGINEERS.
May 9. Secy., Parker N. Black, Capitol Block, Atlanta, Ga.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 9. Secy., F. C. Osborn, Case Library Bldg.

DENVER SOCIETY OF CIVIL ENGINEERS.
May 9. Secy., F. E. King, Jacobson Block.

NORTHWEST RAILROAD CLUB.
May 9. Ryan Hotel, St. Paul. Secy., W. D. Crosman.

NORTHWESTERN SOCIETY OF ENGINEERS.
May 9. Secy., D. W. McMorris, Burke Block, Seattle, Wash.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
May 10. Wichita, Kan.

NEW ENGLAND RAILROAD CLUB.
May 10. Secy., F. M. Curtis, O. C. R. R., Boston.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
May 11. Secy., F. W. Mowbray, Norton Building.

ENGINEERING ASSOCIATION OF THE SOUTH.
May 11. Secy., W. G. Kirkpatrick, Nashville, Tenn.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
May 12. Secy., D. W. Meeker, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
May 13. Secy., F. D. Jones, Helena.

COLUMBIAN ENGINEERING SOCIETY.
May 16. Secy., F. W. Hart, Washington, D. C.

WESTERN RAILWAY CLUB.
May 16. Secy., C. F. Street, Rookery Building, Chicago.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 16. Secy., R. H. Clark, Pittsburg.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 17. Secy., L. V. Carmait, Roanoke, Va.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 17. Secy., F. Collingwood, 127 East 23d St., New York.

BOSTON SOCIETY OF CIVIL ENGINEERS.
May 17. Secy., S. E. Tinkham, 36 Broomfield St.

ENGINEERS' CLUB OF ST. LOUIS.
May 17. Secy., Arthur Thacher, Odd Fellows' Building.

NEW YORK RAILROAD CLUB.
May 18. Secy., H. G. Prout, 73 Broadway, N. Y.

ENGINEERS' CLUB OF CINCINNATI.
May 18. Secy., J. P. Wilson, 34 W. 4th St.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO
May 18. Secy., C. F. Franson, Portland Block.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
May 19. 201 Washington Building.

CENTRAL RAILWAY CLUB.
May 24. Secy., S. W. Spear, Buffalo, N. Y.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
May 26. Secy., C. H. McLeod, Montreal, P. Q.

ENGINEERS' CLUB OF MINNEAPOLIS.
June 1. Secy., E. Nexsen, 504 Kasota Block.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
June 5. Secy., C. L. Annan, City Engineer's Office.

ENGINEERS' SOCIETY OF PHŒNIXVILLE.
June 6. Secy., W. Haliburton.

WESTERN SOCIETY OF ENGINEERS.
June 7. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCN.
June 19. Lakewood, N. Y. Secy, Angus Sinclair, New York.

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To Americans the methods of handling railway baggage on the Continent and in England are amusing, when they are not exasperating. Of course we have in this country the great advantage of an absence of frontiers and custom-house officers in our trips by rail from the Atlantic to the Pacific coasts of the United States, and our simple baggage checking system under these conditions relieves the traveler from all care and responsibility. But even on routes lying wholly within a European state the present practice could be very much improved, and worry and valuable time saved to the traveler, by adopting methods a little more like our own, and injecting a little more promptness into the service. Spanish railways, slow and uncertain in all things, are perhaps the worst offenders in regard to the transportation of baggage, as every traveler will remember to his cost who has had this unfortunate experience. It is not at all an unusual thing to spend an hour in buying a ticket, having a trunk weighed, settling for extra weight and waiting for the exasperatingly slow official to fill out a written receipt for the same; and as this Spanish handler of baggage does not believe that it is within the range of human exertion to ship a trunk inside of 20 minutes, the baggage-room is closed fast 20 minutes before the advertised hour of train departure. The remarks of the hustling American who reaches the station inside this time limit are apt to be somewhat sulphurous. In France, Germany and Italy the system is about the same as in Spain; but as the officials are usually more energetic the delay is not too wearing upon the patience of the traveler. England practically makes every man responsible for his own baggage; and at the terminus of a route he can pick his own trunk—or that of any one else, apparently—from the van and drive away with it, but, owing probably to police supervision at the stations there is surprisingly little robbery. The American baggage checking system was tried in England a few years ago, but except for transatlantic travel in connection with the London & Northwestern and Midland railways, it is practically abandoned. While the railway company will take your trunk and ship it to any designated point, directly from your house, it gives no receipt or other token of identification, and you simply trust to luck and the railway, and your own eyes and word of mouth, for the recovery of your baggage at the terminal station.

That Englishmen recognize the shortcomings of their present practice is evident by the plans suggested every now and then for some improvement in the handling of luggage. The latest is illustrated in the London "Engineer," and is styled by that journal "a very ingenious scheme." This particular device is intended to facilitate the transfer of luggage to the guards' van, or into the "luggage cupboard." It is a cage with low wheels that will just fit in the space provided in the van. This cage stands filled at the station upon a small truck provided with a track, that must be just as high as the car-floor. When the train comes in, this truck and its baggage-cage is brought opposite the car-door; a drawbridge is dropped down and the cage is rolled in, if the car is empty; or another arriving cage, full or nearly empty, is just rolled out on another truck to make room for the cage with departing baggage. As we understand the device, it would apply only to terminal points, and is not adapted to local traffic at all; no provision is made for exchanging anything except full and empty cages, and as the cage fills the van no rearrangement can be made while the train is moving. Similar cages, or strong wooden cars, have long been used in this country for the handling of express matter in and about terminal stations and across ferries; but we do not think that there is much chance for the adoption of this latest English plan in the United States. We can see some use for it, however, in transferring parcels and valuable baggage between two distant points like London and Paris, when it can be locked up and shipped from train to steamer as a whole.

Among the other desirable features of legislation which failed to command enough support to carry them through the last Congress, perhaps none was really more deserving than the recommendations of the Commissioner of Patents in reference to changes in the patent law in order to reform some undoubted abuses which now exist. His chief recommendations were the following:

An amendment compelling an applicant to take action upon his application at least once in every six months, in lieu of once in two years, as at present, and a further provision that a patent shall in no case live for more than twenty years from the date of the first application thereof. The adoption of such amendments would put an end to keeping applications for patents pending many years prior to issue.

An amendment abolishing interference contests in the Patent Office and relegating them to the courts. These interferences are, to all intents and purposes, lawsuits between two or more parties who are seeking to patent the same invention. The Patent Office has not the power to compel witnesses to behave properly in these matters. It has not the tribunals adequate for the trial of the cases, and they entail a grevious burden of work upon the office, which, distributed among the different courts, would not be felt as a sensible addition to their labors. Moreover, a court adjudication of one of these cases would be of great practical value to an interference contestant, which value is wholly lacking in an adjudication given by the Patent Office, and the cost of the litigation in a court could not be greater than it is at present.

The provision making a double limit to the life of a patent, viz. (1) 17 years from the issue of a patent, as now, and (2) 20 years from the date of first application, is especially important and desirable. In effect it allows three years, and three years only, for all preliminary procedures in regard to the application, declaring that if the contest be prolonged beyond this, it shall be at the expense of the life of the patent. Should this be made law, the change from a two-years to a six-months' limit for the period within which some action must be had seems superfluous; in fact, there seems no need for any limit other than the three years for the entire procedures. With interference proceedings before the Patent Office, as now, the three-year limit might work occasional injustice, since the time consumed in such proceedings might be, in a large measure, beyond control of the applicant. But with all interference contests transferred from the office to the courts, this would not be so. The office would act according to its own judgment in giving or withholding a patent, with perhaps a single hearing, or two, in respect to alleged interference; and then, in either case, the party feeling himself aggrieved by the issuing or withholding of a patent, has his remedy before the courts, but with the difference that he cannot, by pretended litigation, prolong his patent indefinitely. Therefore, the owners of both patents have a strong inducement to hasten a decision as much as possible.

THE IDEAL ENGINEERING SCHOOL.

II.

The education of military and naval officers is in every country carried on by the government, and as national self-preservation requires that it should be as perfect as possible, and as no considerations of expense prevent making it so, it has probably been more carefully studied, and brought to greater perfection for its purpose, than any other form of education. We may take our own military and naval academies as about the most perfect development of such schools, and if we admit, as we must, that in many important respects the knowledge and qualities required for a good military or naval officer differ from those required for the three "learned professions" only to agree with those required for the successful practice of engineering, the methods and practices in which they differ from the "learned" professional schools will surely deserve careful study as creating a strong presumption that the highest type of engineering school should also differ from them in an analogous way. In every one of the following respects the qualities required in a good military officer differ notably from those required in the so-called learned professions, and bear a pretty close analogy to those required in a good engineer, either civil or mechanical.

The military man does his work, not in a solitary and self-centered way and in a narrow and purely intellectual line, but as a unit or cog in an organization of men, in which there is place and necessity for both high and low, and in which each must co-operate faithfully with the rest to have the organization as a whole effective. He has to draw his conclusions not as matters of certainty from certain fixed premises, if he can find them, but by striking an average of probability from a variety of highly indeterminate facts, such as the peculiarities of human nature, the degree to which fidelity can be expected from men, weather probabilities, the probable nature of various earths and materials, and the like. The military officer, therefore, needs rather a broad and general than a deep and narrow culture; a knowledge of men and of things, rather than of books, though he needs that too in his special line, and will rarely reach the highest success without it, as our late war amply proved. Not by favoritism but by virtue of special knowledge ground into them at West Point did the leading generals on both sides gain their pre-eminence. The few apparent exceptions, like General Terry, had for the most part gained that prior special knowledge by prior private effort, and without it did not succeed; though that knowledge was only to a limited degree a knowledge of books and book records.

The good military officer, also, needs a sound bodily training; needs to be inured to hardships. He needs to be able to put himself with a cool head in all sorts of unpleasant positions and exposed situations. He needs to be able to march further, ride harder, stand bad food better and stand bad weather longer than any of the men under him, in order to inspire proper respect in them, and get the most out of them. He needs manual dexterity of many different kinds, so that there is nothing which men under him have to do but what he can do as well, or, if that may not be, at least judge of better than they can.

The good military officer also, like all men whose success in life depends on successfully maintaining relations of trust with many other men, needs to be a man of truth; a man whose word can be implicitly accepted, and who is felt to mean at all times exactly what he says and to say exactly what he means. As it is not permissible to say always nor often just what one means or thinks, he must also be a taciturn man, not only in words but in manner; doing often what he feels is a mistake with as much zeal and fidelity as if he believed it would be a success, and making every effort to have it so. This is necessary to the individual, not only that the machine as a whole may be effective, but also that he individually may succeed in life; because all men whose advancement depends on the favor of those who rank above them and not merely on themselves, must know how both to BE faithful and to SEEM faithful to those above them.

We will stop right here and interject a word of advice to young engineers and especially young

graduates. The above is the rock on which many bright young men split, owing largely to their defective training. They are cheeky and "lippy." They have not in them the instinct of subordination, of co-operation and of self-effacement to a common end. They have been little trained in this, but for their own good it should have been hammered into them until it was as much a part of their nature as the air they breath. Because they know some things better than their superiors, they too often think they know all things better; or because they know all things better which are taught in schools, they think they can do all things better, not realizing how great an element in all engineering work is that "horse sense" and knowledge of the common things and common men of life which comes only with years of practical experience in doing things.

Now in a certain sense it is not too much to say that in every one of the three "learned" professions an ingrained habit of truthfulness rather impedes than aids material success. Who wants or who permits even a clergyman to get up in his pulpit every time he feels a doubt about some dogma of his sect, and frankly state his doubts and discuss the matter from the other side, as he might some question of wordly evidence? He may not do it without risking his position and chances in life. From a purely worldly point of view his chances of an easy life are better if he has no qualms about quietly passing them by, or even dwelling on the pros and avoiding discussion of the cons. If so constituted mentally that he cannot do this he stands a good chance of being in hot water much of his life.

Much more is this true with a lawyer. His strict line of duty is to "lie on one side and then turn and lie on the other." The ability to do so with perfect ease and every appearance of sincerity is a large part of his stock in trade. With the physician it is much the same. He must never deceive himself, but it is his right and at times his duty to deceive his patient. And as one use of "language is to conceal thought," a free flow of smooth words is useful for this purpose also in all of these professions. In the military professions, and in any other where the success of all depends largely on relations of mutual confidence between man and man, talkativeness and untruthfulness of word or deed are almost the worst of vices—speaking always, we repeat, from the mere point of view of worldly success. In all this class of professions fidelity is the card of cards; again and again it has given and will give the game to men of inferior mental gifts while the "smart Alecks" sit by and wonder, with a handful of trumps which they do not know how to use. Accordingly, it would be extremely stupid for military schools to do nothing to develop and make instinctive that noble virtue in young aspirants for such professions, and we do not find them falling into that error. On the contrary they dwell upon it persistently and most successfully.

The good military officer also needs, not only nor chiefly for his own comfort or dignity but even more to avoid friction and antagonism in his enforced and constant relations with other men of his own profession, certain social qualities, habits of neatness, and the like. In this the distinction between the military and the so-called learned professions is less marked, because in every sort of calling these qualities have a decided bearing on success. But most of us have known gruff and unmannerly or untidy doctors or lawyers whom we yet trusted greatly, and employ persistently, and the reason is plain: We who employ them are not of their profession and do not care a button for it as a body, nor (necessarily) for the individual whom we employ, as a man. We care only for the "peaked" side of his brain which has been developed abnormally in a certain line of knowledge, which we need for a time and then dismiss.

When the men on whom we depend for advancement are men of our own profession, who have to be in close relations to us for months or years; who have a strong esprit du corps, and look upon an unmannerly or untidy associate (even if they are more or less so themselves) with intense dislike as thereby disgracing them as well as himself; who desire first of all (as most of us do, though we may not confess it) personal acceptableness in those who immediately surround us, and mental qualities afterward—it becomes a very different matter. Then the young aspirant for advancement who has been trained to make himself personally agreeable to others as a man, and not simply as an incarnated brain, has an immense advantage over the man who merely knows things; an advantage such as he would not have in any one of the learned professions, with the partial exception of the ministry. But even in that one has to be trained chiefly to please the general public, not the leaders of one's own profession, and the principal agent for pleasing the public is the gift of tongues.

If those of our readers who are really interested in this question of engineering education, and who are trying to see if they cannot find a few grains of truth which they may usefully apply in these articles, will pause here a moment and read over again the preceding summary of resemblances and differences, following out to the end in their own way the analogies and contrasts so imperfectly presented, we think they will end with the conviction that, in order to give the kind of training that will be most effective toward success, the lawyer, doctor and minister and the future military officer need a different training in many important respects; and that in most of these points of difference, not to say all of them, the training most likely to benefit the young engineer is assimilated to that required for the military officer and differentiated from that required for the lawyer or doctor.

In large degree also we may find that what has been said about the similitude of the best education for military officers applies also to the higher grades of business life, like manufacturing, contracting, railway management and foreign commerce, in all of which the qualities of mind required for success are very similar to those required in engineering, so much so that some of the most important departments of work for engineers are in these lines. This is dimly recognized in the popularity of "military schools" as a preparation for business life, though no one ever dreams of sending a youth to them to prepare for any of the learned professions, however remotely. The popularity in our judgment is not without reason.

As a natural consequence of the differences in requirements we find some noticeable differences between good military schools and law or medical schools. The most conspicuous, perhaps, is one on which we have had more or less to say already in these columns—the length of the college year. Instead of devoting only a few hours in the day for five days in the week and for eight (or nine) months in the year to the work of instruction, and letting the student do as he will for the rest of the time, the West Point cadet is practically under instruction for twelve hours a day and seven days in the week and twelve months in the year; because he is allowed only one comparatively short vacation in the middle of his four-years course, and was allowed no more when the course was five years long. Why? Because the fact is recognized that there are many other things besides book knowledge which go to the making of a good officer. He is not required to do greatly more study or recitation work in a year than at civil colleges—not more than is easily accounted for by the fact that the government is giving an expensive education gratis and may probably exact more; but all the nooks and corners of time throughout the year, all the loose minutes and hours and days and weeks which cannot be devoted to more study without overtaxing the men, are devoted to training in other matters, largely physical, which do not overtax the brain, but rather relieve it, and yet are just as essential to the finished officer.

Now we hasten to admit, on the other side, first, that the future soldier needs much more of physical drill and training than the future engineer, and secondly, that because of its relations to the cadet the government can exact much more than any school which depends on the favor of students for support, or at least that they think they can or know that they can; though we are not quite clear whether it is so in fact. If the doors of West Point were open to any student who would pay the full average cost of tuition and $200 per year besides, we fancy it would be overcrowded with students, though the cost per year would then be fully twice as much as at any civil college. If so, it is only because they will not, not because they cannot, that our engineering schools do not imitate any and all desirable features of military training. But in any case, why do they not at least make a beginning toward a like thorough training in non-studious matters by using some of the spare time to that end which they throw away in vacations? Most of them have made what may in a sense be called a beginning, for they all have a certain quantity of field training, or its equivalent for mechanical and mining engineers; but where is the engineering school which turns out graduates who are experts in pacing distances, or in estimating distances or altitudes, or in estimating the slopes and falls of streams and surfaces, or in guessing the sizes of miscellaneous blocks of wood and iron, or the size of a room or box; or who are masters of instrumental fieldwork, or of making stakes, or of guessing the radius of curves, or of pitching a tent, or even of chaining? These are all of them highly useful accomplishments which it costs nothing to teach, except incessant practice for a time. Some little is done in these lines at all our schools (enough to talk about in the catalogues at every one of them), but if there be one school which teaches them thoroughly, as all easily might, we do not know of it; and the above is not the end of the list by any means, only an off-hand beginning. Troy has made preparations to do this kind of work more thoroughly than it ever has before, by devoting a month, which used to be vacation, to such work, and we gladly record the fact to its honor. A difficulty at many of the schools is that the professors know but little more about such matters from the practical side than the students, and this is another reason why a greater variety and extent of practical exercises is desirable at our engineering schools. It would tend to keep the professors in touch with the practitioners of what they profess, instead of leaving them to become a class apart, as they do to too large an extent.

This brings us to another feature of military schools deserving of imitation by engineering schools. The good military officer needs to be a master of two great arts—how to obey and how to command. So does the engineer. His work through life is to command and manage men. Accordingly we find that military schools lay great stress upon drill to this end. The plebe finds that a large part of his instruction comes, not from professors, but from his fellow-students of higher classes. He is first drilled by them in the art and practice of obeying, and afterward drilled in the art and practice of commanding by having like duties to discharge in his turn toward succeeding classes. The effect is most healthful on the morale of the school and the quality of the graduates.

Now, the engineering schools have just as great an opportunity to teach this just as necessary lesson to their students by drilling their students in the abstract arts of command and of obedience at the same time that they are drilling them in the practical side of their profession more thoroughly than now. The boys would enjoy it if they once had a chance at it. Give them something definite to do and to finish in which there could be some emulation and they would enter into the work with enthusiasm. It would improve the tone of the schools immensely. The freshmen should be axmen and stake-drivers and chainmen for a whole year, and made to work hard at it; the sophomores, chainmen and rodmen; the juniors, instrumentmen; the seniors, chiefs of parties. The result would be, with the right man managing the whole, that without taking an hour from studious work (rather the contrary) the graduates would come out from a four-years course finished chiefs of parties, prepared to take their stand from the beginning pretty well up on the ladder, or to go rapidly up it if starting from the bottom.

Nothing of the kind is done in any engineering school known to us. Probably there are some faint beginnings toward it in some of the schools, it is so obviously wise and so easily done; but we are sure we do no injustice to any school in saying that the thing is not systematically organized on a large scale and as a leading feature in any one of them. Almost without exception the field instruction is given exclusively by the professors; the boys are boys throughout. One school announces in its catalogue, as if it were a merit, that "it is not attempted to complete any particular

work." The result is that engineering students graduate as undisciplined as so many chickens in habits of command and of obedience. It is in the blood of the race to "catch on" to these things quickly, and most of them are fine young fellows who recover lost ground fast; but they have to recover it, and the worst of it is that, as with all other defects of early training, struggle as they may, they can never fully recover ground thus lost in youth. To a large degree the die is cast; they are what they have been made, and cannot make themselves over.

As a general average, it is our deliberate judgment that about two years' time is thus lost to the student without a shadow of necessity, with the addition of occasional permanent incapacity for high positions from lack of early bending of the twig. If so, it would be difficult to exaggerate the immensity of the error.

That we do not overlook nor unduly belittle what is done in this direction will appear, we hope, before we are through. Some of the catalogue statements read as if we were unjust, but between catalogues, implications and facts there is often a large hiatus. We are not through with our subject, but we may as well stop here for this week.

Continuous street-railway rails are to be tried upon the West End line in Boston, says the "Herald" of that city. An apparatus has been designed to weld the rails together by electricity as the track is laid, and to thus do away with fish-plates, bolts and chairs. A motor dynamo is to be placed upon a car and supplied by a current taken from an overhead trolley wire, but on the car the direct current is to be transformed into the kind desired for electric welding. A crane of peculiar construction will carry the welder proper, and hydraulic motors will be used for making some of the adjustments, and small electric motors will operate emery wheels for cleaning off the rail. The welding process is the same as that used at Johnstown, Pa., for a similar purpose, and about three minutes is the estimated time for making a joint. The managers of the line expect that the life of the whole rail will be much increased by the absence of joints; that the track will be smoother, the noise less, and, finally, that this continuous rail will carry back the current to the dynamo and prevent it from so seriously affecting the gas and water pipes.

Two different electric railways between Baltimore, Md., and Washington, D. C., are being talked of, and if reports be true, there is a prospect of one or the other of them built. One of them is being promoted by the syndicate controlling many of the more important street railways in Baltimore, and which has been securing similar interests in Washington, and is projected to run from Washington, D. C., via Hyattsville, Laurel and Elk Ridge, to Baltimore, Md. It is stated that the surveys for this line have been made, and that the necessary permission to enter Washington has been secured. The route of the other line is farther west and somewhat longer, passing through Ellicott City and Sandy Spring, Md. This scheme is backed by Baltimore, New York and Boston bankers, and the necessary charters for building the road have been secured. No definite plans for the construction of either of these lines seem to have been made, but it is stated in a general way that work will be begun this year.

The J. P. Holland submarine boat is to be tested, among others, by the U. S. Navy Department under the act appropriating $200,000 for this purpose. The general dimensions of this boat will be 135 ft. long, 16 ft. wide and 10½ ft. depth of hull. The displacement will be 296 tons, light and 352 tons when submerged to the water line. The weight of water-ballast is 56 tons. The boat is to be protected by 24 ins. of steel armor in front and 4½ ins. on the sides and back of a turret, situated on the upper part of the vessel. One-inch plating and cocoa cellulose protect the sides above and below the light water-line. When ready for action from 4 to 6 ft. of water will cover the entire boat, excepting only a part of the turret. This turret incloses a pilot-house, air-shaft for ventilation, a smoke-stack, and a companionway. Should the forward part of the vessel be struck by a torpedo the boat would not be disabled, as only the chamber for water-ballast would be broken into. The armament is to consist of two submarine guns—one in the bow and the other in the stern—capable of throwing 200 and 100-lb. charges of high-explosives to a distance of 300 ft. Projecting from the turret are three other 100-lb. aerial torpedo guns, with a range of 1,700 yds. The forward submarine gun is 10 ft. below the water surface and is 30 ft. long by 12 ins. in diameter. The engines are 1,500 HP., capable of giving a speed of 18 knots light, or over 15 knots submerged. Coal or petroleum may be used for fuel.

LETTERS TO THE EDITOR.

AMERICAN, ENGLISH AND INDIAN RAILWAYS.

Sir: I have read with interest the articles on railway management in India," and "American and English Train Loads," in your issues of April 6 and 13, and the questions discussed bring up a great deal of matter to think over.

Respecting the railways in India, I do not think there is any country in the world where the tare (that is, the dead weight compared with the paying weight), is less than on those railways. Even the French lines, with all their packing of passengers, do not leave so little tare as the passenger trains in India. The trains are run infrequently, and packed almost to discomfort in so warm a climate; but as the Government Director of Indian Railways said some years ago "cheap fares are stronger than caste," and the ryots and the zemindars, who would not dream of touching each other in ordinary life, travel in the same compartment long distances. The tare of the freight trains I imagine is also favorable on the Indian lines.

Touching upon the character of the works in India, I am not quite sure that you have given sufficient thought (I merely throw this out as a suggestion) to the occas'onal strength of the rivers there. Some of the earlier works of the Indian railways, in the form of bridges, succumbed in the rainy season, and hence the apparently disproportionate expense gone to in structures now that appear to be intended to outlast the ages. You can understand that this is especially true in the neighborhood of the Ghauts (on the east coast) and the Himalayas; but whether the engineers have gone to extremes may be open to question. No doubt in Lower Bengal, and possibly in Madras, there may not have been the same reason for the vast expenditures in the form of bridges, and so on, that there was in the higher districts of the East Indian Ry., the Peninsular Ry., in Bombay, and other main systems.

I quite agree with you in the general principle that railway works have been far too costly. In India, of course, there were two reasons for this: First, the engineers naturally followed the home system in the strength and solidity of their works; and, Second, that either being directly or indirectly subordinate to the government engineers in the construction, in the very nature of things, the works were costly. Then it must be remembered also that in the earlier days the transportation of the material for the railways was a very costly process in a country with little or no means of transportation for weighty articles, nothing better than ox teams and similar rude methods.

I have not kept posted regarding the financial status of Indian railways for the last few years, but I am aware that the East Indian Ry. many years ago passed the point of being a paying institution; and passed that point while being able to show that it had the lowest freight charges in the world. It carries grain from the northwest provinces into Calcutta at a less rate than obtains in the United States. Some years ago an officer was sent by the government of Bombay to inquire how it was that the East Indian Ry., with the immense Ganges River as a competitor along its whole length, was able to be a paying institution, while the Great Indian Peninsula Ry., of Bombay, with no similar competition, was far from being able to make so good a showing; the sum of the report of this officer was to the effect that the competition of the Ganges did it, for the East Indian Ry. officials finding that they had to meet a sharp water competition had, of necessity, to economize in every possible direction, with the result that Mr. Crawford, the then Chairman of the company, and Mr. Rendell, the Consulting Engineer, assisted by the Government Director of Indian Railways, elaborated statistics of almost every portion and every kind of traffic, and, in fact, of every detail of the railway system, such as have not been issued by any English-speaking country, nor approached in any form save in connection with railways of New South Wales. I rather think that since Mr. Danvers ceased to be Government Director of the Indian railways the statistics issued have been altered, and do not now contain the same useful information that they did in his time. It was a pet project of Mr. Danvers, which does not seem to have been appreciated by his successors. Perhaps, indeed, it did not suit the policy of either the government or some of the Indian railways to continue to disseminate such information. So much for Indian railways.

As to British railways, I am doubtful regarding the better economic results of the American over the British railways. Of course, it is useless to resort to statistics or financial statements of British or American railways to arrive at any definite conclusions; as for purposes of investigation and strictly accurate knowledge they are utterly worthless, and that fact should never for a moment be lost sight of. For example, "Poor's Manual" and the government returns of British railways show that the working expenses of railways in the United States range from 10 to 12% higher than those of British railways; but I fail to see how such statements can be accepted as worth anything when anybody who has any knowledge of railway finance, either in the United States or Great Britain, knows that there is not one railway out of twenty that does not keep an open capital account, and uses and abuses it, according to circumstances. To illustrate, the London, Chatham & Dover Ry. for three years past has paid (and possibly for years to come will pay) no dividends, but as a line it is certainly appreciating in value; having no great financial credit it could only issue additional capital at a great sacrifice, and, hence, items that perhaps even the London & Northwestern Ry. might charge to capital are by the poorer company included in current working expenses, as they ought to be. I might go on increasing illustrations from railways on either side of the Atlantic, but the sum and substance of all is that, until there is a positive law, as obtains in France, not to leave to railway companies to say what shall be charged to capital and what shall be charged to current working expenses, there can never be any actual knowledge of what it really costs to operate the traffic of any road. In France, I suppose you are aware, the government, having subvented the lines, claims the right to examine their accounts and see that their bookkeeping is according to law and order; and I understand further, that the same set of accountants do not go continually to the same company, but rotate around the various systems, so that, I presume, if there should be any doubtful case passed by one set of accountants it would be apt to be unearthed by the succeeding set. The absence of any such arrangement is a fundamental defect at the very threshold of any inquiry, and bars true comparisons of railway results.

Now, as to the actual operating. I am not quite sure that the large freight cars you speak of would be adapted for a great proportion of British traffic. I grant you that in the case of coal it might, but for the ordinary freight traffic of British railways it is very doubtful. To take an inverse case: I understand that some years ago the New York Central R. R. ordered quite a number of small freight cars, intending to keep them solely for local freight purposes, but it very soon came home to them that, while the cars themselves were perfectly adapted for the purposes for which they were intended, the switching incidental in yards and stations to collecting them together in trains for local traffic far outweighed any possible gain in any other direction. Again, I remember the time when the Great Northern Ry., the Midland Ry., the Northwestern Ry. (and, I presume, the Lancashire & Yorkshire Ry.), in England, and the North British Ry. and Caledonian Ry., in Scotland, permitted the coal traders in their several districts to supply their own coal cars. This arose, no doubt, in great measure, from the railway companies being unwilling or, at the time perhaps, financially unable to supply the equipment as quickly as it was demanded by the growing output; but the time came, however, when it was found that the assorting of these several traders' cars at their distributing depots became a source of immense expense. In other words, if a trader required, say, 100 cars, how easy it would be to send that number if the first hundred at hand could be taken promiscuously; but when the hundred had to be picked up out of the whole cars in a depot, you can easily understand the time and expense involved in the switching. Hence the determination of the companies to buy up all the cars of the several coal companies that operated over their roads, and hence, also, the very varied character of the cars, in build relative weight and capacity; so that even if the companies were to begin to adapt a standard car, say, of 15 or 20 tons capacity for coal purposes, it would take quite a number of years to get rid of their old equipment. It should also be borne in mind that possibly the equipment at the collieries might have to be adapted to the larger cars, and that might constitute a stumbling block, for a time at least. Then, as to freight or merchandise, probably another consideration comes in. I do not think a very large car would be a paying one for the British railways, for the very simple reason they have nothing anologous to the grain traffic of this country. The bulk of their traffic consists in manufactured articles, and manufactured articles very seldom go in carloads. In other words, the great bulk of merchandise on British railways is in small quantities, and it is carried shorter distances than in the United States; and I think, also, for the same reason, that for the number of their trains there will relatively be a greater amount of switching at stations. The latter, however, is a matter regarding which one would require to have considerable and intimate knowledge to be able to speak positively.

I remember that what you say regarding increasing the loads at the same time as increasing the speed was tried some years ago on the Caledonian Ry. Then, as now, that company sent an immense coal traffic to the north, and, to save getting additional equipment, coal trains were run at a rate of about 40 miles an hour from Lanarkshire to Aberdeen, and, in fact, coal trains had the right of way over all other trains; and, although I have no knowledge of the results, I understand that after a year or two the effort to save money in that way was given up. I should be glad myself to

know the results achieved in such an experiment, because it seems to me it ought to have been a success, inasmuch as if a train was run, say, at about two-thirds more speed than an ordinary train, it is clear that about two-thirds less equipment would be necessary, and a similar additional value would be got out of the crews' wages, while no additional cost would be incurred with respect to signalmen, gatekeepers and station expenses. There would, of course, be additional expense in fuel, coal, oil, etc., possibly, also, in locomotive and car repairs, and very likely in maintenance of way to keep it in a high state of efficiency.

There is, of course, comparatively little of long-journey traffic in Great Britain, except the coal traffic that I have mentioned, as well as the coal traffic of the Great Northern Ry. and Midland Ry. into London, and, no doubt, also from the Manchester, Sheffield & Lincolnshire Ry. and the Lancashire & Yorkshire Ry. districts. But here comes the difficulty of increasing loads and speed—all British railways of any volume of traffic have at least five classes of regular train service, as follows: 1, Slow, or stopping passenger trains; 2, quick passenger trains; 3, slow or accommodation freight trains; 4, quick or through freight trains; 5, coal trains. In addition, the cattle traffic from the north of Scotland, from Ireland, by way of Holyhead and Bristol, brings another class of traffic by both the East Coast and West Coast routes. The cattle traffic from the north of Scotland (Aberdeenshire) years ago had the right of way over all other trains except the limited mails; and the master mechanics at the several depots on the Caledonian Ry. were not permitted to be absent day or night without personally seeing the cattle train pass their station, and, if need be, have a special engine in readiness either to take on the train or to lend any necessary assistance. The same, I presume, was true south of Carlisle; and I have no doubt was also true on the North British, the Northeastern and the Great Northern railways, which formed the opposition route. You understand, of course, that the cattle had to be in Smithfield market, London, at a certain time, and an hour or two's delay would be disastrous.

Another instance of the same kind in the south of England can be pointed out. At certain seasons of the year, the London & Southwestern Ry. runs special express trains with cauliflower and other early vegetables such as are grown in the Scilly Islands, those trains getting precedence over others, and the carriers at the freight station in London are under contract, and a penalty, to have the produce delivered in Covent Garden Market at a given hour every morning during the season. A special class of traffic also may be mentioned in connection with the Great Eastern Ry. from Harwich into London. I presume you are aware that the Great Eastern has boats which ply between Antwerp and some other of the Netherlands ports, among other things bringing continental produce, which, of course, requires to be on time in the London morning markets. These examples might be multiplied, and one may require to know the peculiarities attendant upon each and every class of traffic, but I merely point out in a general way that in addition to the five regular classes of traffic that I have enumerated there are other miscellaneous classes that add to the difficulty of operating the railways.

To take another phase of the question: you are no doubt perfectly familiar with the system that prevails around London, and very largely carried out by the London, Chatham & Dover and Great Eastern companies, of what we may call "touting" for passenger traffic; that is to say, when a suburban field is to be developed they throw a railway or a spur of railway into it, and keep a train service upon it far out of proportion to the necessities of the first population; but having in view that it is only by that means that they can encourage suburban settling, and it is not long until the first losses are compensated for. Look, for example, at the enormous development of suburban traffic by the Great Eastern Ry. into its Liverpool St. terminal station, London. I have no doubt that the season-ticket traffic into Liverpool St. is now the largest in London; of this I am not quite sure, but I know it is immense.

The Pullman sleeping, parlor and dining cars are, without any doubt, thoroughly adapted to the United States, where long journeys are so much in vogue. They might possibly also, if there was a consolidation of railways on the continent of Europe, be useful, say, for the through passengers between Havre or Paris and Brindisi, and other points in Italy, etc. The late Mr. Allport, when General Manager of the Midland Ry., was the first to introduce Pullman cars into Great Britain, and Allport was the first to admit that he made a mistake. He had simply introduced a new and costly and a heavy car, without any adequate remuneration; and it must be so when the journeys are at most from 200, 300 and seldom equal to 400 miles. In fact, the distance from London to Inverness is about 600 miles, and a very liberal train service is provided between London and the north of Scotland by both the East Coast and the West Coast routes. The companies make a point never to pack their trains, but give everybody a sufficiency of room, so that if they desire to stretch themselves they can do so; but as to sleeping cars being used by the British people I believe it is out of the question. I have never yet heard of any company that looked upon them as anything else than a costly luxury; and as to the tare or dead weight involved in them, it would be a nice question for serious examination. There can be no doubt whatever that the dead weight of the United States passenger trains is out of all proportion to anything on the face of the earth. Of course, you can answer me by saying that the public have the advantage in a stronger car, and, consequently, greater security in the event of a wreck; but even that is doubtful of admission so long as a single day coach is permitted to be part of a train with Pullman cars: in the event of trouble it simply means the destruction of the lighter car. Apart from the tare or dead weight, I do not think that experience has demonstrated the value to the British railways of the long cars. Long cars, I recollect, were used years ago on the Glasgow and Greenock section of the Caledonian Ry. In the summer months the tourist travel being very large, the majority of people do not care to take the boats from Glasgow direct, but take them from Greenock (going down by train from Glasgow) and then distribute themselves through the various watering places around Loch Long and Loch Lomond. The experience was not favorable to their use for two reasons; first, they were considered hard to pull—that, of course, was a practical difficulty that I have no doubt has been got over since by the use of the truck,—but the disadvantage that has not been overcome is the fact that the means of ingress and egress were too limited. I suppose you have been in the Tyne districts of the Northeastern Ry., and possibly also in the manufacturing districts of the Lancashire & Yorkshire Ry. On these lines the traffic is practically an omnibus one; that is to say, they unload and load their trains at almost every station, and it would not be possible to run them in anything like reasonable time if they had to depend upon the means in ingress and egress at either end, as in our United States cars. I am aware that the elevated railways here do a very large station to station traffic; and do it, perhaps, as quickly as the Metropolitan lines in London; but you know how the guards are abused by the public for their incivility, whereas they are simply compelled to be thus apparently uncivil, that time may be made with the trains. There is no similar charge of incivility on the Metropolitan lines in London, because the people get in and out of the several compartments without any difficulty, and in very quick time. Of course, it would be easy to multiply instances of the kind I have mentioned; as, for example, on the Caledonian Ry. and North British Ry., in the neighborhood of Glasgow particularly, both going through an extensive mining district, and their local trains being practically emptied and loaded at every station. There is one point, however, that can be conceded, and that is that on through trains, both on the East Coast and West Coast routes in Great Britain, it would be easy to suppose that they could improve, or rather, adapt, their service for the long journeys; but of late years, I understand, they have made considerable progress in that direction. But I reiterate that so far as improving that service in the shape of Pullmans it is a mistake; and I regard the advantages to be gained out of Pullmans in this country as bringing more glory than gain, but still, now that the American people have been educated to them, and the long journey traffic existing, there is no alternative but to continue it.

In all I am attempting to say, I am not combating any of your views, but merely pointing out what I think may be material for further reflection rather than what will actually enable you to arrive at any definite conclusions. In fact, the more one considers railway questions, the more he feels himself driven against a wall of blank darkness. It is to the disgrace of railway management—speaking particularly of English-speaking countries—that after 66 years of railway experience there is not a single constant known to railway practice. Railway managers may say, or pretend to say, that they know the cost and gain of this, that or the other, or of every class of traffic, but they know perfectly well that in making the assertion, if called upon to prove it by absolute data, they go beyond their depth. The necessary information does not exist, and no sufficient effort appears to have been made to acquire it; rather, I think, there seems to be a dread that such data ever should be obtainable, so that any clear light could be thrown upon the intricacies of railway working. They seem to think that there is security in mystery. Railways.

(We print the above letter with special pleasure for the reason that the writer is a railway man of extensive experience in this country and abroad, and has given much attention to the economic principles of railway construction and operation. The railways of India are almost phenomenal in the lowness of their rates, and yet many of them pay good dividends, because these low rates have developed large traffic from very unpromising sources. As to the bridges in India, we fully recognize the difficulties that were encountered, but in these and other works there was the tendency to architectural effect which marked some of the early works on English railways, and which were very much out of place on pioneer railways in a new country, and it was the tendency of the engineers to follow English lines of practice, without due regard to topographical or commercial conditions, which led, in a great measure, to unnecessary first cost. As an instance, Colonel Kennedy, who was connected with some of the early Indian railways, advised the government, in an official report, to limit the grades to 1 in 2,000, or practically 2½ ft. per mile, and this even for a line from Bombay to climb the precipitous sides of the Ghats to the high central plateau. But, fortunately, the board of engineers to whom the report was submitted for advice thereon considered this recommendation, and others of a similar character, as entirely too sweeping and as likely to be injurious to railway development in India. We have already pointed out in discussing Indian and colonial railways (Eng. News, Aug. 4, 1892) that government works are almost invariably more costly than those carried out by private enterprise, because government engineers are not trained to a perception of economic principles. As to the East Indian Ry., a note on p. 363, in our issue of April 20, shows its good financial standing.

The references to government control of railway construction in India, and of railway operation in France, seem to show that while government ownership or operation of railways has not in general been satisfactory, a certain amount of government regulation of railways in general is desirable, somewhat on the line of the Interstate Commerce Commission, but with greater authority. As to the freight cars for English railways we distinctly stated that we did not propose the long cars for general freight, but for coal traffic, and as the cars for this traffic are not used in other service there would seem to be little trouble in keeping them together for the heavy coal trains, without getting them mixed up with the ordinary freight cars. The English railway companies are largely discouraging the private ownership of freight cars, owing to the difficulties referred to by our correspondent.

As to English passenger cars we cannot quite agree with our correspondent. The Midland Ry. runs ordinary first-class compartment cars in the same trains with the Pullman drawing-room cars, and thus does little to popularise the latter, and as far as comfort and convenience go, we (speaking from extensive experience on both sides of the Atlantic, as also does our correspondent) consider the American type of open car (not necessarily a Pullman or palace car) infinitely preferable to the English type of compartment car, particularly for journeys of over 50 miles. As a matter of fact the Scotch trains are often inconveniently crowded, and even at ordinary times one compartment may be full and the next comparatively empty, yet no better distribution can be effected until the next of the few stops is made. We recognize that American palace cars have a very excessive dead weight and we have commented on this fact before, but we are strongly of opinion that a car could be designed for English service which would have the comfort and convenience of the American car without its excessive dead weight, and be at the same time far superior to the English type of car, which often has too little dead weight for easy riding as already noted. The steady introduction of long cars with trucks by English railways shows their appreciation of the advantage of this system of running gear over the English rigid wheel base system. Even the radial axle has been largely abandoned for the trucks, as noted in our article on the London & Northwestern Ry. dining cars in our issue of April 27. An arrangement affording more facilities for ingress and egress than the single door at each end of the car is certainly desirable for heavy short distance traffic, and the traffic on the Metropolitan Ry. (underground), London, could be operated more promptly than it now is by the better use of the brakes. At present the trains crawl into the stations in a way that invites passengers to get off before the train has stopped, as noted in our issues of May 2 and June 13, 1891. At the same time it must be borne in mind that the requirements of this short distance traffic are very

different from those of long distance traffic. It is to be hoped that some way may be found of procuring accurate and comparable statistics of cost of railway operation, etc., for at present, as our correspondent says, comparisons must of necessity be very unreliable owing to the varying systems of keeping records and accounts.—Ed.)

INDIAN RAILWAYS.

Sir: Your article on "Railway Management in India," in your issue of April 6, is based on such very erroneous data that I think it worth while to send you a contribution of fact on the subject. As to the first cost of Indian railways, it is now a matter, for the most part, of the past. As to the management and working, there are no railways in the world that show better results, and few so good. Of course the conditions for economical working are in many cases very favorable, but I venture to think that these advantages are fully made the most of.

Some of the main features in the results of the working of the East Indian Railway are stated in the pamphlets I inclose, and they are open to any criticism you care to bring upon them. I think you have at least as much to learn from us as we from you.

Yours truly, R. Strachey.
Chairman, East Indian Ry. Co.

London, April 21, 1893.

(In reference to the above letter from Lieut.-Gen. Sir Richard Strachey, it must be remembered that our article dealt with the railways of India in general, and not with any Indian railway in particular, except in so far as special cases were cited. The pamphlets sent are the addresses made by the chairman at the company's meetings, and contain much interesting information which we shall abstract later, together with information from other sources. General Strachey is not quite correct in regarding first cost of railways as largely a matter of the past. Railway construction is going on, and should go on, in India, and to a large extent the work seems to be done with the lack of appreciation of topographical features and economic principles which has been such a marked feature of colonial railway construction. The particulars already published from time to time, including those given in the article on "English Railway Practice in India and the Colonies," in ous issue of Aug. 4, 1892, as well as the statements in the Indian papers, show that some engineers and others in India recognize the present defects in methods of construction, management and administration, while the haphazard way in which the gage question is handled by the government and other authorities, as already pointed out, is in itself a striking example of Indian railway affairs. The East Indian Ry., as shown by a note in our issue of April 20, is a good paying concern, but it is one of the oldest lines, and has built up for itself a good traffic, as stated in the foregoing letter signed "Railway." The direction in which the economic (not economical) principles of railway construction and operation should be especially considered is in that of extending the railway system of India by main and feeder lines to develop the commerce, resources and industries by improved transportation facilities, particularly for districts in which the present traffic prospects are poor and unpromising, and at the same time to give due consideration to the strategical side of the question. The railway system of India is very far from being complete as yet. We entirely agree with the idea expressed in the last sentence of General Strachey's letter, and we have several times pointed out the advantages which would follow a more familiar knowledge on the part of engineers and railway men of the principles and practice which obtain in other countries.—Ed.).

THE SEWAGE FARM AT THE HOSPITAL FOR THE INSANE, LONDON, ONT.

Sir: My attention has been called to an article entitled "Sewage Purification in America" in your issue of April 6, 1893, in which a description is given of the new sewage farm at Berlin, Ont., from material furnished by Mr. Willis Chipman, of Toronto, who designed the works.

Permit me to correct a statement in the first paragraph of that article, to the effect that the Berlin farm is the first sewage purification work built in Canada, "aside from a few for private institutions" (sic).

So far back as 1888, the government of this province took steps to lay out a sewage farm at the asylum for the Insane at London, Ont., with the double object of remedying a long-standing nuisance and of providing an object lesson for the towns and municipalities of the province.

The work was put into operation in July, 1889, was designed by Col. Geo. Waring, of Newport, R. I., and has turned out a complete success generally.

The provincial government has also since then constructed works for sewage disposal at Guelph, Belleville and Mimico for the use of the public institutions there. Mr. Chipman must be well aware of these facts, as he has, I believe, visited London, and has, to my knowledge, made inquiry as to the methods to be adopted at the other places mentioned.

The government of Ontario is decidedly entitled to the credit of being the first in the province to construct such works, and Colonel Waring to that of being the designer of the first sewage farm in Canada.

I inclose a paper read by me at Owen Sound before the Provincial Board of Health upon the working of the London farm in 1890, and refer you to the "Engineering Record" of March 7, 1891, for a description and diagram of the London farm.

Kindly give this publicity, and oblige,

Yours truly,
Toronto, Ont., April 27, 1893. C. G. Horetzky.

(The full sentence from which Mr. Horetzky quotes is as follows:

So far as can be learned, the only sewage purification plant yet built in Canada, aside from a few for private institutions, is located at Berlin, Ont.

The words "a few for private institutions" were intended to cover just the sewage purification plants mentioned by Mr. Horetzky, it not being borne in mind when the words were written that the institutions were public instead of private. What was really meant was that the Berlin plant was the only one yet built in Canada for the purification of the sewage of a town, and in this it still appears that we were correct.

In fairness to all concerned it must be added that the above reference was made by ourselves and not made or even suggested by Mr. Chipman. The series of articles on "Sewage Purification in America" has thus far been entirely restricted to plants built for the purification of the sewage of towns, with the single exception of the Mystic Valley works, built by the city of Boston to purify the wastes from a number of tanneries located in the drainage area of the Boston water-works.

STRENGTH OF DOUGLAS FIR.

Sir: Noting the communication of Mr. W. B. Wright in your issue of April 20, relating to the strength of Oregon or Douglas fir timber, I inclose some documents which may be of interest. Further information on the subject may be found in a paper by Mr. Onward Bates, in the "Transactions of the American Society of Civil Engineers," November, 1890, page 261.

Yours very truly,
John C. Trautwine, Jr.

Philadelphia, April 24, 1893.

(The documents referred to by our correspondent quote the results of a number of tests on the transverse strength of Douglas fir published in the Report on the Forest Trees of North America, by Chas. S. Sargent, issued by the Census Office in 1884, and two other tests made by the Oregon & California and Northern Pacific railway companies. We do not publish these as the report of Mr. Sargent and the article of Mr. Onward Bates are by far the most important and valuable, and both are easily accessible.—Ed.)

THE WADLEY CONTINUOUS DRAWBAR.

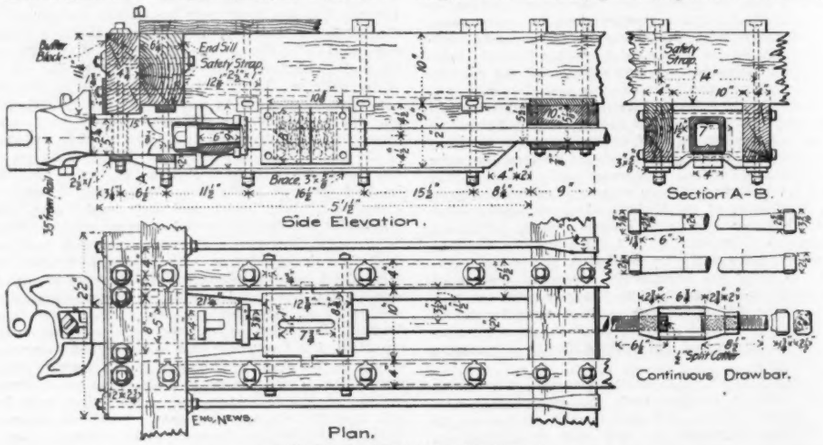
We illustrate herewith a continuous drawbar and draft rigging which has been applied to about 1,200 cars on the Central R. R. of Georgia, and is reported to have given the best of satisfaction. The apparatus was designed by Mr. Geo. D. Wadley, General Superintendent of the Central R. R. of Georgia, for the purpose of obviating the difficulties due to the breakage of the tail bolts of M. C. B. couplers. Mr. Wadley writes us:

Fully three-quarters of all the wrecks on the Central of Georgia within the past year have been caused by the failing of automatic couplers on the track, through the breakage of the ordinary tail bolt which has been in use. The key either drops out or the key itself breaks on account of the sharp jerks (occasioned by lost motion) which are given in handling the cars.

The principle of a continuous drawbar is recognized as being correct, but I have never been in favor of any of the applications which have so far appeared on the market. In searching for some way to prevent accidents, which were of frequent occurrence from the inherent weakness and insecurity of the arrangement in use on the Central R. R., I hit on the application of the continuous drawbar principle which is shown in the accompanying blue-print. It is easy of application to cars of any class, and costs no more than the American continuous drawbar. I have placed this drawbar on 1,200 cars of the Central of Georgia R. R. during the past eight months, and it has filled most acceptably the want which we have felt on this line for several years past. So far, none of the various master mechanics on this road have reported any trouble with the arrangement. It has stopped the breakages of automatic couplers, which have been a source of considerable expense to this company.

It will be seen by the drawings that two vertical lugs are cast on the shank of the M. C. B. drawbar, and after the bar is put in place a safety strap 2½ ins. × 1 in. is bolted onto the end sill behind the carrier iron. Tie-irons on each side carry the strain on this safety strap back to the draft timbers, when the spring is compressed to its full limit and the drawbar lugs strike the safety strap.

The continuous feature of the draft gear is a single 2-in. rod running the length of the car and



WADLEY CONTINUOUS DRAWBAR.

connected as a tail bolt to the drawbar. To meet the difficulty with the breakage of the tail bolt just under the head, the end of the rod is enlarged from a 2-in. diameter at the tail of the bar to 2 1/16 ins. diameter under the head, thus increasing the section at the point of most frequent breakage about one-third. The head is 2½ × 3 5/16 ins., and 1¾ ins. thick. To provide for ready removal of the continuous rod and its adjustment, it is joined by a turnbuckle at the center and this is secured by a ½-in. split cotter to prevent it from turning.

It will be seen that the whole arrangement combines the advantages of the tail bolt and pocket systems of attaching the drawbar. The drawbar can be easily removed when necessary for repairs, and yet it cannot be pulled out and fall upon the tracks if the tail bolt breaks.

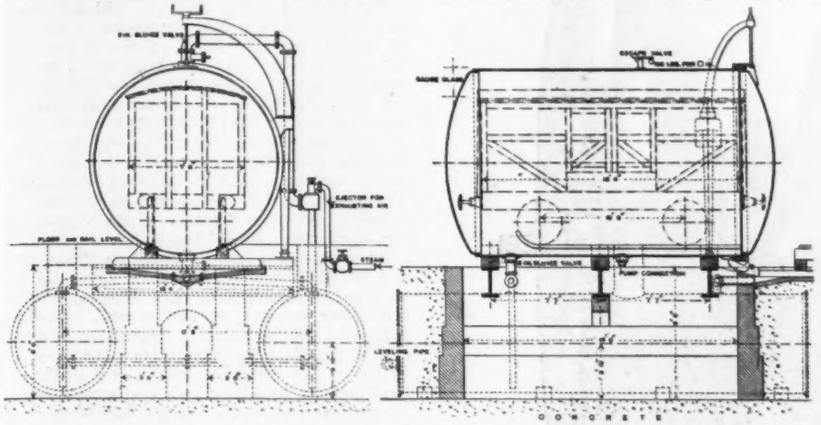
A patent (No. 493,319) for the combination of the drawhead and conical headed tail bolt has been issued to Mr. Wadley, the claims being as follows:

1. In combination with the drawhead of a railway car, a draw rod or bar having a conical or tapering enlargement seated within said drawhead, and joining the body of the rod at so slight an angle as to avoid the formation of a shoulder or well defined line at the meeting point.

2. In combination with the drawheads, a drawrod connecting said drawheads, and consisting of two sections united by a turnbuckle, the ends of the draw rod sections within the drawheads being formed with conical or tapering enlargements of long and gradual taper, substantially as and for the purpose set forth.

CREOSOTING FREIGHT CARS.

The London & Northwestern Ry., of England, has at its freight car works at Earlestown an interesting plant for creosoting coal cars and cattle cars after construction. The plant was built at the company's works at Crewe, and we are indebted to "Industries" for the accompanying cuts and particulars. The creosoting chamber is a cylinder 12 ft. 6 ins. diameter inside and 22 ft. long, built up of ⅝-in. steel plates. One end of the chamber is removable, being swung from a crane, and when closed has a lead joint and is held in position by 18 cast steel clamps hinged to the end of the cylinder, and tightened by set screws. The chamber has a gage glass, pressure gage and a relief valve loaded to 100 lbs. per sq. in. A car is run in on its own wheels, the springs, however, being removed, and when the chamber is sealed a vacuum is created by a Meldrum ejector, and the creosote rises through the supply pipes from the storage tanks underneath. When the cylinder is nearly full the ejector and admission valve are shut off, and



CREOSOTING PLANT FOR FREIGHT CARS; LONDON & NORTHWESTERN RY.

the force pump set to work, which fills the chamber and raises the pressure to 100 lbs. per sq. in., the whole operation lasting about 20 minutes. The car is kept under pressure for about three hours, after which the discharge valve in the bottom of the cylinder is opened, allowing the creosote to flow back to the tanks. The car is then run out, and left over a concrete channel for the creosote to drain off, the drippings flowing to a pipe leading back to the tanks. The track is of bridge rails on 9×9-in. longitudinal timbers supported on cross timbers 10 ft. 2 ins. long, the ends of which rest on the sides of the concrete channel.

The cut shows an ordinary English cattle car in position for creosoting, the car being 18 ft. long over the body, 7 ft. 11 ins. wide, and having a wheel base of 10 ft. The sides are open above the horizontal rail, an iron rod being run across to prevent the animals from getting their heads out.

A BROAD PATENT ON THE ELECTRIC TROLLEY.

The General Electric Co., through its subsidiary corporation, the Thomson-Houston Electric Co., has just become the owner of a broad patent on the trolley system of operating electric railways, and we understand that steps will be taken to protect its rights under this patent. The patent (No. 495,443) was issued April 11, 1893, to the administrators of the late Chas. J. Van Depoele, and by them assigned to the Thomson-Houston Electric Co. The broad claims allowed are in substance the underneath contact with the conductor, made either by a rolling wheel or a sliding spoon-contact piece, and the reversibility of the trolley pole on top of the car enabling the contact to be made on either side of the trolley. We reprint some of the important claims of the patent as follows:

1. The combination of a car, an overhead conductor above the car, an upwardly extending and laterally movable arm carried by the car and having its upper end free, and a contact device carried by the arm at its free end, and making underneath contact with the conductor.

4. The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor, and an arm on the car movable on both a vertical and a transverse axis and carrying the contact device.

15. In an electric railway the combination of a car, a conductor suspended above the line of travel of the car, a rearwardly extending arm pivotally supported on top of the car so as to swing laterally and provided at its outer end with a contact device engaging the under side of the suspended conductor, and a tension spring for maintaining an upward pressure contact with the conductor, substantially as described.

The application for this patent was made in 1887, and we are informed that extended interference proceedings have delayed its issue. Of course the validity of the patent will be contested by the General Electric Co.'s rivals, and years of litigation will probably intervene before the patent is sustained or defeated.

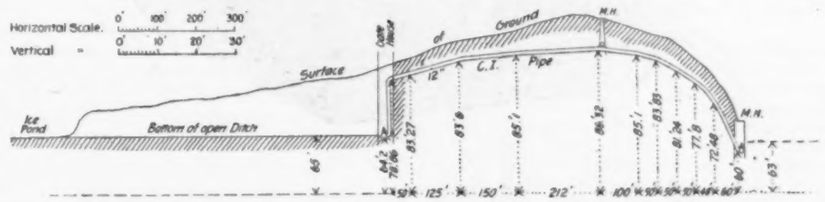
SIPHON ON THE WATER SUPPLY OF MOUNT VERNON, N. Y.

A 12-in. siphon, 925 ft. long, with a maximum lift of 22.12 ft. and a 45° change in alinement was put in use in 1892 by the New York City Suburban Water Co., which supplies Mount Vernon, N. Y. The siphon is shown by the accompanying profile.

The original source of supply drawn upon by the New York & Mount Vernon Water Co., which has been succeeded by the present company, was Hutchinson River. The New Rochelle Water Co. also draws its supply from this river, above the pumping station of the Suburban Co., and as the New Rochelle Co., in accordance with legal form, resolved to build its reservoir first it has a prior right to the water of the stream. This finally compelled the Suburban Co. to secure an additional supply, which it did in 1892 by purchasing and enlarging the Mahlstead ice ponds, located over a ridge from the Hutchinson River. The first enlargement of the ponds was made by raising the dam 3 ft., which gave a total capacity of about 20,000,000 gallons. This has been increased to about 60,000,000 gallons and the enlargement will continue until the capacity is 200,000,000 gallons. The drainage area tributary to the ponds is about 1,000 acres, mostly farm land.

An open ditch leads to the gate-house at the inlet end of the siphon. This ditch at the gate-house end is 19½ ft. deep, 35 ft. wide on top and for the lower 7 ft. of its depth is in rock.

The gate-house is of masonry. The level of the water in the ditch or creek at the outlet is 63 ft. above datum, making a difference in level from the top of the intake valve of only 2.2 ft. The outlet discharges into a wooden manhole and has 3 ft. of water above the bottom of the pipe. From this manhole a ditch extends to the Hutchinson River at a point above the pumping station.



PROFILE OF SIPHON ON THE WATER SUPPLY SYSTEM OF MOUNT VERNON, N. Y.

At its summit the siphon crosses the 12-in. supply main of the New Rochelle Water Co., which is tapped by ¾-in. lead pipe, used to charge the siphon, the water drawn from the New Rochelle main being measured by a Crown meter.

The original air chamber at the siphon consists of a 12-ft. length of pipe connected to the siphon by means of a quarter-bend and T, thus giving a 12-in. chamber 16 ft. long. A ½-in. tap and cock at the top of the chamber provide an outlet for the collected air.

It was found that the siphon with air chamber as described would run until 125 cu. ft. of air had gathered, and that this took place only half as soon with a 14-ft. lift as with the full lift of 22.12 ft. The siphon will operate about 12 hours without being recharged, but more water can be gotten over by charging every six hours, and can be kept running 23 hours out of 24 with only one man in attendance, he having time to eat and sleep without relief.

With the siphon as described above it is necessary to close the valves at each end of the siphon to recharge it.

A plan to obviate this is under consideration, but may not be necessary, it is stated, when the water level of the reservoir is raised to 88 ft. above datum, as proposed.

It has been found by weir measurements that the discharge of the siphon, before air accumulates at the summit, is practically the same as through a straight pipe.

Mr. J. M. Howells, of Chicago, is chief engineer for the New York City Suburban Water Co. and M. J. N. Chester is constructing engineer, and to them we are indebted for this information.

THE OTTO GASOLINE ENGINE.

A special distinguishing feature of gas, gasoline and petroleum engines is that they are internal combustion engines, the fuel being consumed in the working cylinder. This type of engine has been described in Engineering News, March 19, 1892, and other issues, and we illustrate this week the Otto gasoline engine, manufactured by Schleicher, Schumm & Co., of Philadelphia, which was described in our issue of Feb. 20, 1892.

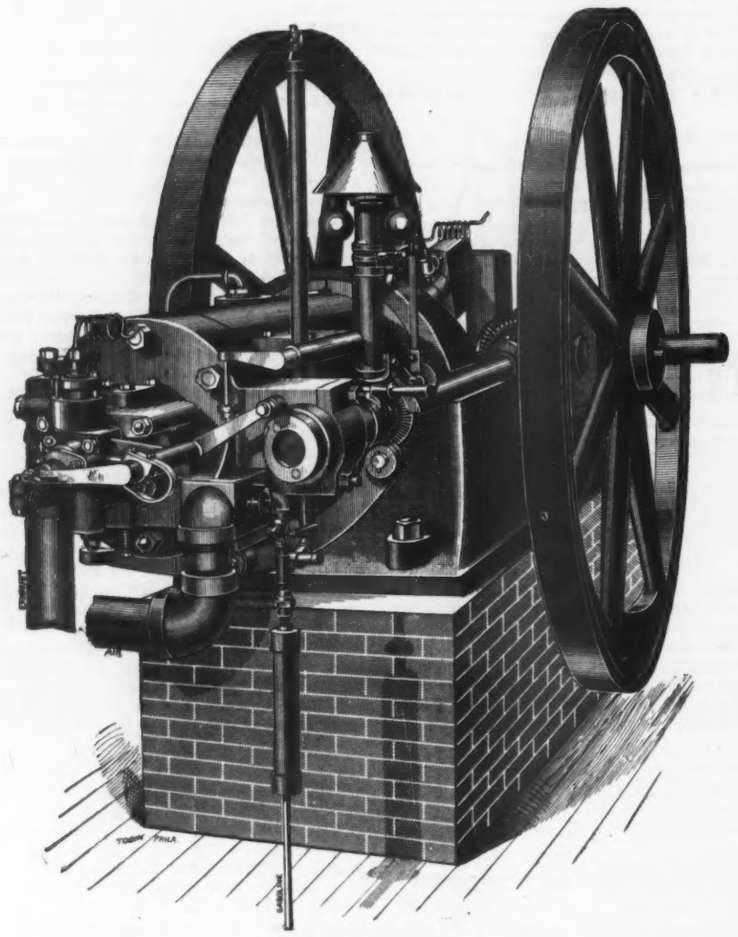
The cut represents a 35-HP. engine. The engines are similar to the Otto gas engines built by this firm, except that instead of gas being drawn in, the liquid fuel is brought into the engine cylinder and when entering it is atomized by the suction of the air charge which is necessary for the combustion. The mixture is then fired by an electric spark at the proper time to develop the maximum pressure at the beginning of the stroke. The fuel is admitted through a poppet valve which is controlled by the engine governor so that the amount admitted is only sufficient to work the engine at uniform speed in proportion to a varying load. A circulation of water is maintained around the cylinder jacket to prevent too high a temperature being reached, but the cylinder should be kept at a moderately high temperature to work economically, a cold cylinder seriously affecting the working of the engine.

The liquid fuel is either pumped from a tank buried under ground to the level of the engine, and the surplus which is not used is returned by an overflow pipe to the same tank, or in the case of the smaller engines the gasoline supply is located at about the level of the engine cylinder, but at any desirable distance away from it or any adjoining building. In some cases the gasoline has also been brought up to the engine cylinder from a tank under ground by water pressure on the "Aubin" system, of which the Otto engine works have exclusive control.

There being no open flame near the engine, as

the ignition is effected by electricity inside of the cylinder, the general safety of the engine is apparent, especially as any leak of gasoline near the engine is excluded, and is possible only by great neglect in making pipe connections and joints. The larger sizes, of 50 HP. and over, have recently been fitted with a self-starting appliance which admits of starting the engines under almost a full load.

The practical rate of consumption is said to be one-tenth of a gallon of gasoline per horse power per hour. This material is worth 8 cts. per gallon in Eastern cities when bought at retail in barrel lots, making the cost per horse power per hour eight-tenths of a cent. It is claimed that in comparing this cost with that of coal at $3.50 per ton it will require 6 lbs. of coal to equal the above



OTTO GASOLINE ENGINE.

cost, so that where but a small gasoline engine is used and the gasoline bought at retail the liquid fuel will be on a par with a steam engine using 6 lbs. of coal per horse power per hour and will besides save all the handling of the solid fuel and ashes as well as the attendance for the boilers. As very few small steam engines consume less than 6 lbs. of coal per hour, this is an exceptional showing for economy. Taking into consideration the larger sizes of engines, such as 50 and 100 HP., for which it would pay to buy gasoline in bulk at the lowest possible rate, the liquid fuel can be had for less than 4 cts. per gallon, being equivalent in coal to 3 lbs. per horse power per hour on the above basis. It is therefore claimed that either for large or for small powers gasoline as a liquid fuel offers great economy when used in an internal combustion engine; it being not only on a par with the direct cost of coal used in economical steam engines and boilers, but dispensing with all the wages involved in the handling of solid fuel, and taking care of the steam boilers.

One of these engines, of 15 HP., has been applied to driving an electric light plant at Taylor's, N. Y. They are also used for furnishing power for machine shops and similar plants, and are adapted for portable engines for agricultural purposes on account of their simplicity. For mining purposes the engine is built in sections for the convenience of transportation and handling.

THE BRITISH TIMBER TRADE.

(From a Correspondent.)

The timber trade of Great Britain during 1892 was exceedingly fluctuating, in some parts there being a considerable increase in the quantity imported, while in others (owing mainly to the action of strikes, and local causes) the decrease was very great. The supply of foreign timber (exclusive of staves and furniture woods) to the United Kingdom in 1892 was 7,563,449 loads as follows:

	Hewn, loads.	Sawn, loads.
Norway and Sweden	782,677	2,046,167
Russia	329,636	1,316,258
Germany	288,614	.....
British North America	194,654	1,212,877
Other countries	873,550	519,007
Total	2,469,140	5,094,309

In London, owing to manufacturing industries being in an embarrassed condition, trade was very dull, while strikes and failures of building societies had also an adverse influence. The annual consumption in London may be roughly estimated at about 29,000,000 pieces of sawn wood (deals, battens and boards) and 2,000,000 pieces of timber, round and square (exclusive of mahogany and other cabinet woods). The trade in Liverpool was adversely affected by the depressed state of the shipping trade, and on the Tyne, owing to a succession of strikes, the imports have shown a decided falling off. The Bristol dock returns for 1892 show a slight decrease in the importation of timber as compared with 1891, amounting to 5,929 loads, the difference, however, being more than accounted for by the fact that during the past year there was no importation of yellow pine for railway longitudinals, as formerly used on the Great Western Ry., whereas in 1891, 6,530 loads of such timber came into the port. At this port also strikes helped to make trade dull. In Scotland the trade was good on the whole, and in Ireland fairly good. In Belfast the imports in 1892 were the largest on record (1,698,358 cu. ft.), and this, notwithstanding that the building trade was interrupted by a strike lasting from May to September.

During 1892 there were 99,000 loads of railway ties imported at London, of which 51,000 were from Russia and 48,000 from Germany. Although this is a slight improvement on the quantity imported during 1891, it is a considerable decrease from the three previous years, which average 108,000 loads each, the highest being 114,000 in 1890. The Great Northern Ry. of Ireland imported at Dundalk its usual annual import of 80,000 pine ties from Riga.

The trade in native timber is still very small, and prices are extremely low, owing to the effect of foreign importations. Oak timber of good quality could be sold at 75 cts. to $1.25 per ft. 50 years ago, but now from 30 to 60 cts. is about the highest offer. Jarrah wood is giving satisfactory results for paving blocks and other purposes, and several large shipments of planks were received at London, while the trade in Indian teak fell off largely owing to the decrease in shipbuilding. Teak from Siam is now almost as favorably received as that from Burmah. There is also an increasing importation of Oregon pine.

An exhibition called the Furniture Trade, Timber and Woodworking Machinery Exhibition was held at the Agricultural Hall, London, in April last, being one of a number of trade expositions held from time to time. It was really an exhibition of first class furniture, there being no exhibit of timber (as such) and only a few exhibits of woodworking machinery, while several firms exhibited gas and steam engines with a few saw benches and wood-cutting tools. Of the wood carving machines one was operated by compressed air, and had the guide point and the cutting point on the same level, the bar supporting them being held by the workman, who thus watched the guide point following the pattern, and the cutting point doing its work at the same time. The other machine was in three stages, with the guide point in the upper working over a bronze copy out of sight of the workman while the two cutters were on lower stages, one under the other, carving two pieces of wood simultaneously, all three points being connected to the same vertical bar by horizontal arms; this machine was worked by steam. A new safety scaffold was also on view. It consists of a hollow square, wooden upright, banded with iron, and with an iron runner, having slots in it, let in on one side. This upright post passes through an oblong cage for two men and materials, which case is raised and lowered by a gear arrangement, worked by two handles, which moves catches from one slot to another, in ascending and descending. Safety is insured by the working parts being so arranged that, before one catch can be removed from the slot where it is supporting the weight of the cage, the other catch must be fixed in the next slot and so relieve the former of the weight. These catches are of steel and will sustain a weight of two tons. The upright stands on the pavement and is kept in position by iron struts at the top, with wheels on them which bear against the wall of the building, so as to admit of the pole being traversed sideways. The men, however, could not work to advantage in such a cage, except for repairing and decorating work, and the whole contrivance appears to be very impracticable for large jobs. The Blackman method of drying or artificial seasoning for timber is reported as giving very satisfactory results. The planks are carefully stacked in the drying-room, reaching from wall to wall and floor to ceiling, leaving only the openings between the planks. A current of dry air heated to about 80° F. is then forced into the room by a fan, and circulates through the piles of timber. Green oak boards can, it is claimed, be thoroughly seasoned in two months, and ordinary floor boards in eight days, if the sap is previously expelled by a special treatment.

MAXIMUM WATER POWER OBTAINABLE FROM LONG CONDUITS.

By Arthur L. Adams, C. E., and R. G. Gemmel, Assoc. M. Am. Soc. C. E.

Corcerning the conditions for securing the maximum amount of power through a long conduit of fixed diameter, without regard to the economy of water, the following analytical solution is submitted:

Let h = the total head.
h'' = the head lost by friction in the pipe.
h' = that remaining at the nozzle end.
P = energy of stream from nozzle.
W = weight of water discharge in unit of time.
Q = quantity of water discharge in unit of time.
V = velocity of stream in pipe.
A = area of cross-section of pipe.
w = weight of unit quantity of water.

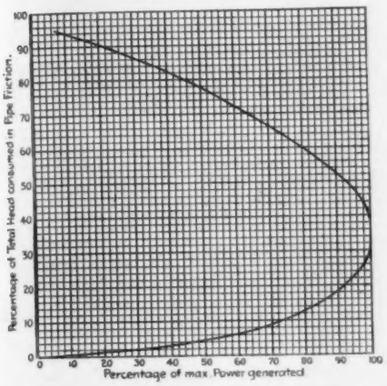


Diagram Showing Maximum Water Power Obtainable From Long Conduits.

d = diameter of pipe.
m = coefficient of flow.
l = length of pipe.
Then $P = Wh' = Qwh' = Avwh'$.

In this last quantity the variables are v and h', and we wish to find their maximum value. By the equation for velocity,

$$V = \sqrt{\frac{2\,g\,h''\,d}{4\,m\,l}}$$

In this quantity h'' is the only variable, hence

V = a constant $\times \sqrt{h''}$ or, since $h'' = h - h'$

$Vh' =$ a constant $\times h' \sqrt{h - h'}$

Then discarding the constant as before, and remembering that if a quantity is a maximum its square is also a maximum, $h'^2 (h - h') = hh'^2 - h'^3$ is to be a maximum.

Differentiating h' we have

$$2\,hh' - 3\,h'^2 = 0.$$

For a maximum, $2h - 3\,h' = 0$, or $h' = \frac{2}{3}\,h$.

Or, in other words, the power plant should be so designed that the draft from the pipe should be such that the frictional loss in the pipe will be equal to one-third of the entire static head.

It will be observed that in this demonstration the entry and velocity heads are neglected, and also the resistance in the nozzle delivering the water to the wheel, but all play an important part usually, and the second and third tend to offset each other.

As to the necessity of having this law checked by any extended experiment, its truth is readily apparent from an inspection of any table of frictional heads and discharges of pipes.

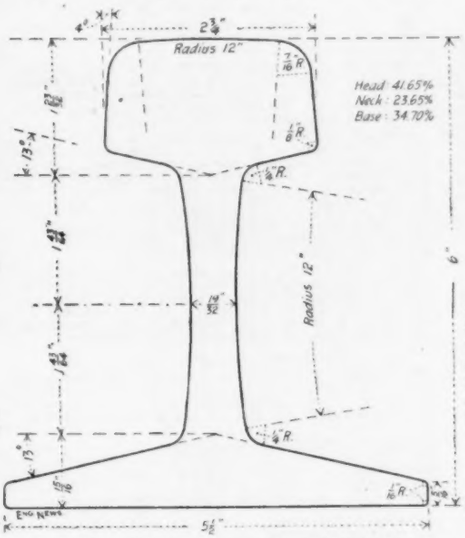
The accompanying curve, constructed from Fanning's frictional tables for 8-in. pipe, seems to make quite a striking illustration of the approximate truth of the law. It was after first observing the law as apparent in such a table that we set about to derive it analytically.

A FAST SIDE-WHEEL STEAMER.

The fastest paddle or side-wheel steamer in the world is said to be the new Belgian mail steamer "Leopold II.," running between Dover and Ostend. The ship and engines were built by Denny & Bros., Dumbarton, Scotland. The ship is 340 ft. long, 38 ft. beam and 14 ft. 6 ins. deep, and the wheels are driven by a pair of compound engines with cylinders 59 × 81 ins. and 104 × 81 ins. The high pressure cylinders have piston valves, and the low pressure cylinders have flat valves. The average speed on the trial trip was 22.16 knots. The vessel is of the ordinary type of channel steamers, having a hull of the same construction as an ocean steamer. There are two masts and two tall smokestacks, and a pilot house is placed at the forward end of the hurricane deck, an improvement upon the usual arrangement of placing the steering wheel on the open bridge. The deckhouse has ten state-rooms, but the main first-class sleeping saloons, for men and women, have open bunks and sofas, an uncomfortable arrangement common on European boats of this class of service, as noted in our issues of March 14 and 21 and April 11, 1891. The second-class passengers' quarters are forward, below the main deck. A sister ship is now being built by the Societe Cockerill, of Seraing, Belgium.

100-LB. RAIL; NEW YORK, NEW HAVEN & HARTFORD R. R.

The advantages due to the use of heavy rails of first-class manufacture on tracks with a heavy and constant traffic are well known and have led to the increasing use of heavy rails on main lines which has been very noticeable for the past few years. The New York Central & Hudson River R. R. and the Pennsylvania R. R. have adopted 100-lb. rails for use on certain sections of their lines (Eng. News, March 19, April 2, July 21 and Aug. 18, 1892), and the New York, New Haven & Hartford R. R. adopted a 100-lb. rail section in March. We are indebted to Mr. F. S. Curtis, Chief Engineer, for the drawing of this rail section from which the accompanying cut is prepared, and an order has been placed with the Maryland Steel Co. for several hundred tons of these rails. The following table gives the dimensions of the three 100-lb. rail sections above referred to, together with those of the 100-lb. mean type of section prepared from the average dimensions of the sections suggested individually by the members of the committee of the American Society of Civil Engineers on standard rail sections (Eng. News, March 21, 1891).

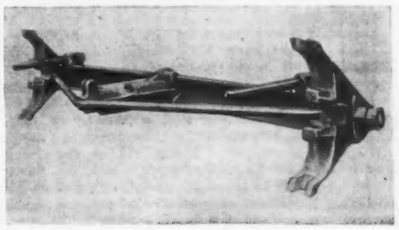


100-lb. Rail; New York, New Haven & Hartford R. R.

	100-lb. Steel Rails.			
	N. Y., N. H. & H. R. R.	N. Y. C. & H. R. R. R.	P. R. R.	M'n Soc. C. E.
	ins.	ins.	ins.	ins.
Height	6	6	5 1/16	5 5/8
Width of base	5 1/16	5 1/4	5 1/16	5 5/8
Width of head, top	2 5/8			2 3/4
Width of head, bottom	2 3/4	3	2 3/4	2 3/4
Slope of side of head	4°	4°	4°	Vert.
Depth of head	1 1/2	1 5/8	1 2	1.672
Height of web	3 1/16	3 1/16	2 15/16	3.018
Depth of base	1 1/16	1 1/16	1 1/16	0.976
Thickness of web	1/2	1/2	1/2	0.69
Thickness of edge of base	5/16	5/16	3/8	
Height to c. of bolt hole	2 1/16	2 5/16	2 3/16	
Radius of top of head	12	14	10	12
Rad. of top corners of head	1/16	1/16	1/16	1/4
Rad. of bottom corners of head	1/4	1/4	1/4	1/16
Rad. of top fillets	1/2	1/2	3/4	1/2
Rad. of bottom fillets	1/4	1/4	1/4	1/4
Rad. of corners of base	1/16	1/16	1/16	1/16
Radius of side of web	12	14	8	Vert.
Fishing angles of head and base	13°	14°	13°	13°
Percentage of metal in head	41.65%	40.8%	49.0%	41.5%
Percentage of metal in web	23.65%	23.5%	18.5%	21.0%
Percentage of metal in base	34.70%	35.7%	32.5%	37.5%

A NEW METAL BRAKE-BEAM.

The brake-beam, of which we give a perspective view, has recently been designed by Mr. Chas. B. King, of the Michigan Peninsular Car Works, Detroit, Mich. The compression member is an angle-iron, and is thus cheaper than the tube employed in some of the metal brakebeams. The tension rod serves also the purpose of securing the brake heads to the compression member and the number of parts is thus reduced to a minimum. We are informed that tests have been made upon the beam which show that it meets the standard requirements of the M. C. B. Association. The beam has been applied to several Hutchins refrigerator cars which are now on exhibition at the World's Columbian Exposition.



New Metal Brake Beam.

THE CANADIAN CANAL SYSTEM.

Mr. Samuel D. Pace, U. S. Consul at Port Sarnia, Canada, in a recent consular report, has something to say upon the present Canadian canal system and the alleged gain to American commerce where it permitted the free use of this system to Montreal.

As many people already know, the Canadian system of canals is made up of the short cuts, or canals extending along the St. Lawrence River from Montreal to Prescott, near Lake Ontario, and the Welland Canal, connecting lakes Ontario and Erie. By aid of these waterways, vessels of moderate size and light draft can pass from the Straits of Belle Isle to Duluth, a distance of over 2,000 miles. And of this total distance, only 71 miles is by artificial canals, the remainder being lakes, straits and rivers.

But the depth of water in the St. Lawrence group of canals does not exceed 8½ ft. in some of the locks; and while the depth of the Welland Canal is 14 ft., the locks are only 270 ft. long. While this depth and length of lock are large enough for any Canadian ship intended for lake navigation, they fall far short of the requirements and dimensions of the later American built lake vessels. Many of these vessels now carry 100,000 bushels of grain or 3,000 tons of ore, and the Welland Canal lock would have to be 50 ft. longer and the channel 3 ft. deeper than they are at present to accommodate them.

In fact, to send our larger lake steamers to Montreal would require the practical reconstruction of the whole Canadian canal system, and the dredging out of the St. Lawrence canals to at least twice their present depth. Even were this done, the great rocks and swift currents in the St. Lawrence would make navigation exceedingly dangerous; for out of the 119 miles between Montreal and Prescott, or Lake Ontario, 75⅝ miles are river navigation.

Mr. Pace concludes that the free use of the Canadian canals would be of no practical advantage to American shipping. But he objects to the

imposition of a tax of 20 cts. per ton now laid upon the smaller U. S. vessels that pass through the Welland Canal in their traffic between the two lakes. The Canadian ships, on the other hand, pass the American canals at the St. Clair Flats and Sault Ste. Marie without toll.

The $1,000,000 Rock Island and Union Pacific bridge built over the Missouri River, at St. Joseph, Mo., is in danger of being left to span a lagoon, says Western dispatches. On April 26 the river cut through back of the government protection works, and the banks crumbled at a rapid rate. Less than an eighth of a mile separated the two channels. Should the river cut through, the entire sewerage system of St. Joseph would be made inoperative.

The total daily dry weather flow of sewage at Toronto, Ont., as determined by gagings made in March, April and May, 1891, was 2,150,901 cu. ft., or 16,131,758 U. S. gallons. The average daily amount of water pumped by the city water-works during the same period was 2,400,000 cu. ft., or 18,000,000 U. S. gallons. The population of Toronto by the census of 1891 was 181,220, which gives an average per capita discharge of sewage of 11.87 cu. ft., or about 89 U. S. gallons.

It was found that one-half of the total sewage of the city flows off in an average of 10.37 hours.

All the main sewers of the city were gaged by means of weirs, and the Francis formula was used for the computations.

The gagings were made by Mr. W. T. Ashbridge, C. E., and first published, with diagrams but without explanatory text, in the report of the city engineer of Toronto for 1891. The results of the gaging in tabular form were reprinted in Engineering News of Nov. 24, 1892, and referred to again in our issue of Dec. 8, 1892. In January, 1893, Mr. C. H. Rust, Engineer in Charge of the Toronto sewers, read a paper before the Canadian Society of Civil Engineers, from which the above is taken, in which he presented the figures and diagrams previously published, gave further particulars regarding the gagings and added a diagram showing collectively the hourly fluctuations of the sewage flow.

The advantage of keeping street railway rails clean was the subject of a paper recently read before the English Society of Engineers, by Mr. H. Conradi. He said that the tractional resistance between clean and dirty rails varied as much as 30 lbs. Cleaning by hand once a day, says Mr. Conradi, costs 25 cts. per mile of single line, in fine season, and twice as much in bad weather. Watering by cart twice a day costs 60 cts. per mile. Cleaning by a special device successfully used on the tram cars of Reading, England, for the last 18 months, costs 12 cts. per day, and even less.

The side-wheel steamer "Leopold II.," recently built for the Belgian service between Dover and Ostend, by Wm. Denny & Bros., of Dunbarton, has a mean speed record of 22.16 knots. This steamer is 340 ft. long, 38 ft. beam, and is 14½ ft. deep. The motive power is supplied by a set of compound engines of the paddle-wheel type, with 59-in. and 104-in. cylinders, with 6 ft. 9 in. stroke. Of the six new steamers built for this service in the last five years, the slowest attains a mean service speed of 19 knots.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

PENNSYLVANIA.—Trains have begun running over one track of the double-track elevated structure through the town of Elizabeth, N. J. It is hoped to have the other track completed by June 1.

NEW YORK, SUSQUEHANNA & WESTERN.—The stockholders of the New York, Susquehanna & Western R. R. Co. and the Hudson River R. R. & Terminal Co., which is building the new tunnel through the Palisades opposite New York city, met recently and ratified the action of the directors, who decided at their last meeting to unite the two companies. Of the 210,000 shares, 176,376 were represented, and voted in favor of the consolidation. The plan of reorganization provides for a capital of $26,000,000 for the new consolidated corporation, to be equally divided between preferred and common stock. The capital of the terminal company ($5,000,000) will be represented by 20% in new preferred stock, requiring $1,000,000 of the new issue. The present preferred stockholders of the New York, Susquehanna & Western will receive $125 in cash for every 100 shares, and 120 shares in new preferred stock for every 100 shares of old stock. This will take $9,600,000 of the new preferred stock, leaving $2,400,000 in the treasury for future purposes. The $13,000,000 common stock of the Susquehanna road will be exchanged share for share for new common stock.

DELAWARE & HUDSON CANAL CO.—This company has begun a survey for an extension of the Adirondack R. R. from Riverside, N. Y., to Schroon Lake, about seven or eight miles long.

COLUMBUS, HOCKING VALLEY & TOLEDO.—This company will expend $200,000 this season in improving its line between Toledo and Columbus, Ohio.

SARANAC & LAKE PLACID.—Active preparations are being made to begin work on this 11-mile railway by the contractors, Brady Bros., Bayonne, N. J. Ch. Engr., Jessie L. Mott, Saratoga, N. Y.

MIDDLESEX VALLEY.—Preparations are being made to extend this railway to Geneva, N. Y. Gen. Man., H. S. Stebbings, Naples, N. Y.

Projects and Surveys.

LACKAWANNA, CATSKILL MT. & BOSTON.—The New York State Railroad Commissioners have granted permission to this company to build its line. The road will start from Deposit, near the Pennsylvania line, where it will connect with Pennsylvania roads, and run directly up the west branch of the Delaware River to the headquarters of Schoharie Creek, and then down the Schoharie Valley to Central Bridge, there to connect with the Susquehanna for Albany. From Central Bridge the new road leads to Rotterdam Junction, to connect with the Fitchburg R. R.

MUSKEGON TERMINAL.—This company has been chartered in Michigan to build a railway from Muskegon to Grand Rapids, Mich. Capital stock, $450,000.

Southern.—Existing Roads.

FLORIDA CENTRAL & PENINSULAR.—About 1,800 men are now at work on the line from Savannah, Ga., to Hart's Road, Fla., 114 miles, and it was expected to begin tracklaying at Hart's Road on May 1. About 55 miles are now graded. The garding is light, but there is considerable bridge work. Contrs., Southern Supply Co., Jacksonville, Fla., Ch. Engr., W. S. Greene.

ANNISTON BELT.—This short belt railway at Anniston, Ala., has been completed.

WHEELING BRIDGE & TERMINAL.—Work has been begun on an extension of this road to Benwood, W. Va. Gen. Man., N. W. Eayrs, Wheeling, W. Va.

MANCHESTER & AUGUSTA.—Surveys have been renewed on the extension from Rimini to Denmark, S. C. It is announced that contracts will be let soon.

Projects and Surveys.

CHATTANOOGA & WESTERN.—A railway company by this name has been chartered in Tennessee.

MISSISSIPPI.—The J. T. Riddle Lumber Company will construct a logging road 10 miles long. Gage, 3 ft. Address, Handsboro, Miss.

JACKSON.—A correspondent writes us that this railway will be only four miles long, and will run from Jackson, La., to the Yazoo & Mississippi Valley R. R. at McManus, La. Work will begin about Nov. 1. Pres., F. Herr, 284 Baronne St., New Orleans, La.

MOBILE & WEST ALABAMA.—The railway surveyed by the state of Alabama, and designed to connect Mobile with Warrion coalfields, at Tuskaloosa, and to proceed thence to Florence on the Tennessee River, has been organized as the Mobile & West Alabama R. R. Co. Col. John T. Milner, of Newcastle, Ala., was elected President, and Judge W. J. Wood, of Florence, Ala., was elected Vice-President. J. H. Tindall, of Mobile, was elected Treasurer, and George B. McKnight, of Mobile, Secretary.

DRY FORK.—The incorporators of this company, which was chartered some time ago to build a railway from Hendricks to Gauley Creek, W. Va., 32 miles, have completed the organization of the company by electing R. F. Whitner, of Philadelphia, Pa., President, and Martin Lane, of Wilmington, Del., Treasurer.

Northwest.—Existing Roads.

CANADIAN PACIFIC.—It is stated that the grading on the line from Ft. MacLeod, N. W. T., and Lithbridge, N. W. T., through the Crow's Neck Pass, is nearly completed, and that the line will be in operation this season.

GREAT NORTHERN.—Newspaper dispatches state that this company has purchased the Sioux City & Northern R. R., running from Sioux City, Ia., to Garretson, N. Dak., 96 miles, and the Sioux City, O'Neill & Western R. R., running from Covington, Neb., to O'Neill, Neb., 129.16 miles. The purchase is said to include the railway bridge now under construction across the river at Sioux City.

DULUTH, MESABI & NORTHERN.—About 1,200 men are now at work on the 27-mile extension into West Duluth. The contractors are Wolf & King, who also have the contract for building the branch from Arr Junction to the Lake Superior Mine, 18 miles. It is stated that work will begin on this last branch soon.

Projects and Surveys.

RICE LAKE, DALLAS & MENOMINEE.—J. E. Horsman, Secy. and Treas., Rice Lake, Wis., writes that the surveys have been completed for this proposed railway from Rice Lake to Dallas, Wis., 20 miles. The contract for building the line has been let to Geo. Anthony, Rice Lake, Wis., and it is expected to have the line completed by July 1. Pres., T. C. Olmstead; Ch. Engr., H. E. Clark; both of St. Paul, Minn.

CHARLES CITY & SOUTHERN.—A stock company with a capital stock of $200,000 has been formed to build this proposed railway from Elma to Webster City, Ia.

DULUTH, RICE LAKE & WESTERN.—Chartered in Minnesota to build a railway from Duluth, Minn., to some point on the Canadian boundary line. Among the incorporators are: Douglas A. Petre, Pres.; Wm. McKinley, Vice-Pres.; Arthur A. Coleman, Secy., and Fred. W. Paine, Treas.

Southwest.—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—Work is being pushed rapidly on the extension from Bowie, Tex., to Ft. Worth, Tex. A preliminary survey has been completed for a further extension to Dallas, Tex.

ST. LOUIS & SOUTHWESTERN.—At a meeting of the directors, to be held soon, the subject of extending the road from Gatesville, Tex., to Hamilton, and thence to Brownwood, Tex., will be considered.

GREENFIELD & NORTHERN.—This company is reported to have begun surveys for an extension from Greenfield, Mo., north.

TEXAS & SABINE VALLEY.—Ch. Engr. Rich. J. Evans, Longview, Tex., writes us that this road is projected to run from Carthage to Center, Tex., 30 to 35 miles, and that the locating surveys have been completed and two miles of track laid. The route is through a rolling, timber country; maximum grade 1%, and maximum curve 3°. The principal business of the road will be in lumber, cotton and general merchandise. Liberal aid in land and money is promised by the people along the route. The two miles of the road now completed is being operated by the Texas, Sabine Valley & Northwestern R. R., and the contract for the remainder has been let to the Texas Construction Co., 15 Wall St., New York, N. Y.

Projects and Surveys.

AUSTIN, BASTROP & COLORADO VALLEY.—Chartered in Texas to build a railway from Austin, Tex., down the Colorado River to Bastrop, Tex. Among the incorporators are Jos. W. Burke, John M. Cortley, H. M. Garwood and others.

WICHITA FALLS & OKLAHOMA.—This company has been organized with an authorized capital stock of $300,000 for the purpose of building a railroad from Wichita to Ringgold, Tex., a distance of about 35 miles, to connect with both the Chicago, Rock Island & Pacific and the Missouri, Kansas & Texas Cos. M. Lasker, H. Kempner and Leon H. Blum, of Galveston; H. Richter, of New York; J. A. Kemp, R. M. Moore, M. O'Riley, W. L. Vickers and others, of Wichita Falls, are the incorporators.

HOUCH'S MISSOURI & ARKANSAS R. R. CO.—This company has been incorporated in Missouri with a capital stock of $250,000.

MISSOURI & TIDE WATER.—The name of the Springfield, Sedalia, Marshall & Northern R. R. has been changed to the above, and grading has been commenced with a small force at Springfield, Mo.

Rocky Mountain and Pacific.—Existing Roads.

RIO GRANDE & WESTERN.—This company will open bids on May 5 for a roundhouse, shop, masonry for turn-table, and masonry and superstructure for coal chutes.

ASTORIA & EASTERN.—Arrangements for the resumption of work on this Oregon railway will soon be made, according to press reports.

SANTA FE, PRESCOTT & PHOENIX.—This line has been completed from Ash Fork south to Prescott, Ariz., and work is now in progress on the further extension to Phoenix. G. W. Vaughn, Prescott, Ariz., Ch. Engr.

EVERETT & MONTE CRISTO.—A press dispatch says: "Work on the Everett & Monte Cristo line has been advanced considerably during the past six weeks. The track-laying through Stillaguamish canyon has reached the second crossing of the river, the first crossing being at Granite Falls. A bridge is now being built over the river, and construction work is going on near the snow line on the mountains. The railroad is being built by the Colby-Hoyt syndicate, of New York, which has purchased the controlling interest in the rich mines in the Stillaguamish region, near Monte Cristo, Wash. The railroad is being constructed to develop this region. The western division of the road between Everett and Snohomish, on the Puget Sound, has just been opened for traffic. The line to Monte Cristo up the Stillaguamish River will be about 60 miles from Everett. The principal mines are at Silverton and Monte Cristo. Those at the latter place are the most valuable."

CHIPPEWA RIVER & MENOMINEE.—This company proposes to extend its line from Devil's Lake to Superior, Wis., this summer.

ELECTRIC RAILWAYS.

WINDSOR, ONT.—The Sandwich, Windsor & Amherstburg Railway Co. has purchased the horse car line, and will at once build an electric railway system. Address W. J. Pulling. The city has granted a 20-years franchise.

NEW BEDFORD, MASS.—At a meeting of the stockholders of the Dartmouth & Westport Ry. Co., the following officers were elected: Pres., Frank W. Brightman, of Fall River; Vice-Pres., Abbott P. Smith, of New Bedford; Treas., J. A. Beauvais, of New Bedford. The committee was empowered to purchase supplies and proceed with the construction of the road between this city and Fall River. Eight electric cars will be ordered at once.

PROVIDENCE, R. I.—Work has begun on the extension of the Union R. R. from East Providence to Bullock's Point.

ELIZABETH, N. J.—The Elizabeth & Plainfield Electric Light Co. has made an application to the street and law committee of the city council for a franchise to construct an electric railway from Elizabeth to Plainfield. The company has ordered its cars and other equipments, and is ready to begin building its road as soon as the city council gives the necessary permission.

WOODBRIDGE, N. J.—Chartered, Woodbridge & Sewaren Electric St. Ry. Co.; capital stock, $50,000; C. W. Boynton.

CHESTER, PA.—A charter has been granted for an electric road which will connect Chester and Media with Rockdale, Glen Riddle and the towns of the Chester Creek Valley. Pres., John B. Robinson; Sec., Edmund Jones; Treas., Edward A. Price, and Solicitor, William Ward.

McKEESPORT, PA.—Chartered, McKeesport & Braddock Passenger Ry. Co.; capital stock, $50,000; incorporators: John D. McCune, Wilkinsburg, Pres.; James McCune, Wilkinsburg; Albert N. Hunter, Knoxville; John P. Hunter, Oakmont.

MEDIA, PA.—Chartered, Media, Middletown, Aston & Chester Electric Ry. Co.; Media to Chester; capital stock, $30,000; John B. Robinson.

PITTSBURG, PA.—The Second Ave. Traction Co., Pittsburg, with a capital of $1,000,000, has been incorporated. The company has been organized for the construction and operation of motor, cable or other machinery for supplying motor power to passenger railways. Directors: James D. Callery, William B. Burns, John C. Reilly, W. V. Callery, George C. Wilson, W. H. Keech, John W. Taylor, Pittsburg.

READING, PA.—Chartered, East Reading Electric Co.; street railway; capital stock, $100,000; Pres., Albert J. Brumbach.

TYRONE, PA.—Chartered, Pittsburg, Greensburg & Latrobe Ry. Co.; electric railway; $1,000,000; Jas. L. Mitchell.

CANTON, O.—An electric railway will be built between this town and Louisville, O., 7 miles. Work is to begin at once.

CLEVELAND, O.—A movement is on foot to build an electric railway from Cleveland, O., to Akron, O. T. S. Gerhard, Independence, O.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Electric Ry. Co. has filed articles of incorporation with the secretary of state. The purpose of the company is to construct an electric line from Indianapolis through Marion, Johnson and Morgan counties, terminating at Martinsville. The length of the road will be 30 miles. The capital stock is $50,000. The directors are: Benjamin C. Stevens, Oscar Matthews, James Stevenson, James C. Devore, Henry A. Smock, John Hardwick

and E. F. Branch. James Stevenson is Pres. and Elliott F. Branch is Sec.

INDIANAPOLIS, IND.—The street railway company whose bid for the new franchise drawn recently by the board of public works was accepted a few days ago, has filed articles of association. The name of the company is the City Ry. Co. Its capital stock is $2,000,000. The incorporators are John W. Murphy, August Kiefer, Frederick Fahnley, Geo. A. Dickson and H. C. G. Bals. Murphy is Pres.; Kiefer, Vice-Pres.; Bals, Sec.; and Fahnley, Treas.

BIG RAPIDS, MICH.—A franchise has been granted to C. E. Wilson, of Chicago, to construct and operate an electric railway and electric lighting plant. It is to be put in at once.

GROSSE POINT, MICH.—An electric street car line is projected through the proposed boulevard along Vernier road to the county line. Detroit parties have submitted a proposition, and the question will be decided soon. The place is a suburb of Detroit.

CHARLESTON, S. C.—The Enterprise St. Ry. Co., mentioned in our last issue as applying to the city council for authority to operate by electricity, has been sold to the Great Western Manufacturing Co., of Chicago and Duluth; T. B. Casey, of Minneapolis, Pres. Contract for the entire electrical equipment of the road has been let, and work will be commenced within 60 days, franchise having been obtained.

COLUMBUS, GA.—The North Higland St. Ry Co. will extend its electric road to make a complete circuit of the city, involving an expenditure of $400,000. Samuel Carter is Pres.

VICKSBURG, MISS.—The Vicksburg St. Ry. Co. and the Hill City Electric St. Ry. Co. have consolidated, and it is stated that this step is preliminary to equipping the railroad with electricity.

HORSE AND MOTOR RAILWAYS.

MIFFLINTOWN, PA.—Chartered Parkesburg & Oxford Electric Ry. Co.; Oxford to Parkesburg; capital stock, $100,000; Pres., John J. Patterson.

GREEN BAY, WIS.—Chartered Fox River St. Ry. Co.; capital stock, $100,000; incorporators, J. T. Chase, C. H. Holmes, Thos. McCullough.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Grand Central Ry. Co. has been chartered to build a system of elevated railways in Chicago. The charter provides for sections of Chicago, and continue beyond the city limits in various directions through Cook county into Kane, McHenry and Boone counties, finally reaching the Wisconsin and Indiana state lines, taking in en route a dozen or more towns and villages. One branch passes on to Lake Geneva, Wis. Inside the corporation limits the proposed road is to be an elevated structure. At the limits it is to drop to the surface. William J. Richardson, John V. Farwell, Robert Meadowcroft, Charles J. Meadowcroft, Frank R. Meadowcroft, William Temple, Frank H. Starkweather, Andrew Petersen, and Edmund Knauer, all of Chicago, are the incorporators. The capital stock is placed at $15,000,000.——The North Chicago Rapid Transit Co., capital stock $10,000,000, has also filed articles of incorporation for the construction of an elevated railway. The road is to extend from a point at Washington and La Salle Sts., north across the Chicago River over a bridge or through a tunnel, to the city limits, with branches connecting with the main line, running northwest to the city limits. The Incorporators are: William Loeb, Abraham Gottlieb, George W. Claussenius and A. Loeb.

HIGHWAYS.

NEW YORK.—The aqueduct commissioners, New York, will receive bids until May 17 for constructing highways and their appurtenances at reservoir M, in the town of North Salem, Westchester Co.

NEW JERSEY.—The freeholders of Hudson county have opened bids for four sections of the new county road known as the boulevard. The lowest bids and engineers' estimates were as follows: Newark & New York R. R. to Newark Ave., and Second St., town of Union, to county line, Hudson County Contracting Co., $24,680 and $27,015; estimates, $26,244 and $39,158; —Newark Ave. to Paterson plank road, and thence to Second St., Curley & Pennell, $21,264 and $29,230; estimates, $28,744 and $35,460.

WATER-WORKS.

New England.

BELMONT, N. H.—The Belmont Aqueduct Co. may build works; estimated cost, $10,000.

CHESTER, MASS.—The town has accepted the proposition of Chas. L. Goodhue, Springfield, to put in works with a gravity supply from Austin Brook, ¾ mile from and 138 ft. above the Boston & Albany Ry. station. The town has the privilege of buying the works three months after completion at cost plus 10%.

MILLBURY, MASS.—A charter has been granted C. D. Morse, H. W. Aiken and others. The town has the privilege of buying the property of the company within 60 days at actual cost.

WEST BOYLSTON, MASS.—The legislature has passed a bill authorizing the town to build works, if it so votes.

SUFFIELD, CONN.—The Suffield Water Co. has been incorporated; Pres., Byron Loomis; Secy., Chas. L. Spencer; Treas., E. H. Phipps. It is said that the contract for construction will probably be awarded to the Mechanical Engineering & Construction Co., New Haven.

WETHERSFIELD, CONN.—The Griswoldville Water Co. has been incorporated; $1,575; J. W. Griswold, and others.

Middle.

NORTH CREEK, N. Y.—The North Creek Water-Works Co. has been incorporated; $15,000.

ST. JOHNSVILLE, N. Y.—Works are projected.

SCHENECTADY, N. Y.—Mayor J. W. Clute has vetoed the ordinance appropriating $88,000 for an additional supply and improvements on the ground that the present and prospective amount of sewage discharged into the Mohawk River above the proposed intake renders it unsuitable for a water supply.

SPRING VALLEY, N. Y.—A test of the water-works of this town was made last week, and demonstrated a pressure at Haight's Hotel of 32 lbs., which was considered satisfactory. Only iron pipe will be laid in the future.

SUFFERN, N. Y.—The Spring Lake Water Co., of Hillburn, has completed its preliminary surveys, and is receiving estimates on pipelaying.

WASHINGTONVILLE, N. Y.—W. H. Cowan, Stamford, and others have applied to the town board for permission to form a water company; proposed capital, $20,000; proposed supply, Jackson's mill pond.

JERSEY CITY, N. J.—Mayor Wanser has vetoed the resolution calling for specifications for a new 48-in. supply main across the meadows on the ground that it is unnecessary.

DU BOIS, PA.—The borough council has voted to rescind the present water contract and call for bids for a new supply.

HELLERTOWN, PA.—Surveys for works will soon be made.

PHILADELPHIA, PA.—Bids for building two 30,000,000-gallon pumping engines have been received as follows, the figures being the price for the two engines: Southwark Foundry & Machine Co., Philadelphia, vertical triple-expansion, $174,186; Groshen High Duty Pumping Engine Co., two triple-expansion, $208,000; Snow Steam Pump Works, Buffalo, N. Y., two vertical, $220,000; L. P. Morris Co., Philadelphia, $232,600; E. P. Allis Co., Milwaukee, Wis., two vertical, $237,000. For three 20,000,000-gallon pumping engines, probably as alternatives to the 30,000,000-gallon, bids were received as follows: Geo. F. Blake Mfg. Co., Boston, $274,650; H. R. Worthington Co., New York, horizontal, $172,000, or vertical, $257,000.

FREDERICK, MD.—Bids are wanted until May 15 for constructing a 6,000,000-gallon reservoir. J. F. Eisenhauer, Chn. W. Com.

Southern.

FARMVILLE, VA.—A 15-years' exclusive franchise has been granted to W. P. Dupuy and J. C. Rawn, Roanoke.

ELLICOTT CITY, MD.—Works are again talked of.

North Central.

LA FAYETTE, IND.—The West Side Water-Works Co. has received a report from Engr. John W. Hill, Cincinnati, recommending a steel reservoir 40 ft. in diameter and 50 ft. high. Experimental wells are being sunk under Mr. Hill's direction.

PRINCETON, IND.—It is reported that the council has voted for works with a supply pumped from Patoka River, five miles distant, and that work will be started at once.

SAGINAW, MICH.—The estimated cost of this years' improvements is $50,000, exclusive of revenue.

DE PERE, WIS.—It is reported that the works here and at West De Pere, owned by different companies, may be bought and consolidated by outside parties, and if so, that they will be improved, possibly by adding pumps. The present supply is by gravity from artesian wells.

Northwestern.

ROCK VALLEY, IA.—The people have voted for works.

BROMFIELD, NEB.—Works are projected.

WHITE SULPHUR SPRINGS, MONT.—It is reported that John S. Miller, Helena, is figuring on putting in works here and if he does nothing a proposition will be made by T. H. Carter.

Southwestern.

ST. LOUIS, MO.—No bids were received in response to a recent request for bids for four 78-in. Belpaire boilers. It is stated that bids will again be asked.

HILLSBORO, TEX.—A franchise has been granted to the Hillsboro Water, Light & Power Co., for both water and electric lights. There will be 50 hydrants at a yearly rental of $50 each. The supply will be from the city's artesian well, which cost about $6,000.

EDMOND, OKLA.—Works are still projected.

Pacific.

MESA, ARIZ.—Water and electric lighting plants are talked of.

Canada.

CHATHAM, ONT.—The company may draw an additional supply from Lake Erie, as the artesian wells, it is reported, are not yielding the anticipated amount.

KINGSTON, ONT.—A contract for cast iron pipe, delivered on the streets, has been awarded to the St. Lawrence Foundry Co., Toronto, at $33.60 per ton, probably the long ton.

IRRIGATION.

TEXAS.—The Chatfield Irrigation Co., incorporated under the laws of Texas with a capital stock of $1,000,000, wishes to correspond with capitalists. The company has a project for irrigating land in Cameron, Hidalgo and Starr Cos. Adrress, Lieut. W. H. Chatfield, St. Francis Barracks, St. Augustine, Fla.

SELMA, CAL.—It is reported that the Sunset Irrigation District has sold $1,600,000 of bonds, and has let a contract for construction to the Portland Construction Co.; Secy., J. N. King.

RIVERSIDE, CAL.—The Olive Irrigation District has voted $60,000 of bonds, and proposes to buy water and pipe it.

NEW COMPANIES.—Park Branch Canal Co., Livingston, Mont.; $25,000. Italian Ditch Co., Park City, Mont.; $10,000. Klickitat Irrigation Co.; Tacoma, Wash.; $300,000. G. W. Thompson, L. V. Loomis, Plunge Creek Water Co., Redlands, Cal.; $100,000; B. J. Waters and F. E. Brown, Redlands; J. I. Clark, New Haven, and others. Stomliam Irrigation & Mining Co., San Francisco, Cal.; $1,000,000. San Joaquin Irrigation Co., Stockton, Cal., $3,000,000.

SEWERS.

SKOWHEGAN, ME.—Wm. Bailey, Malden, Mass., has been engaged to make surveys and specifications for a system of sewerage, and the selectmen are reported as receiving bids for the construction.

BOSTON, MASS.—The metropolitan sewerage commissioners will receive bids until May 13 for section 43¾ of the main sewer, in Medford and Somerville; length, 2,315 ft.; average cut to 10 ins. below invert, 12.2 ft.; maximum outside width of masonry, 63 ins.

HOLYOKE, MASS.—Henry Winkler, Supt. of Sewers, informs us that the city will contract for laying 8,000,000 brick in sewers this spring, excavating to be done by the city; also for about 40,000 ft. of different sizes of sewer pipe.

LEICESTER, MASS.—Surveys for a sewer are being made by H. O. Smith, Constr., and Mr. Craig, C. E., of Spencer.

NORTHAMPTON, MASS.—The sewer commissioners report that it will cost $40,000 to build the sewers petitioned for. An additional appropriation is desired.

NEW HAVEN, CONN.—The committee on sewers has recommended the construction of sewers in eight streets.

NORWALK, CONN.—The city councilmen have appropriated $8,500 for rebuilding the Ann St. sewer.

BROOKLYN, N. Y.—The commissioner of city works will receive bids until May 10 for four sewers.

CAZENOVIA, N. Y.—J. A. Looyster informs us that the Stanwix Engineering Co., Rome, is making surveys for a sewerage system, but that the village has not yet voted on the question.

ILION, N. Y.—An election will be held May 6, to vote on the sewer question. The proposed system is estimated to cost about $65,000.

NYACK, N. Y.—The village board has appointed W. T. B. Storms, C. De Baun, Dr. E. H. Maynard, E. B. Sipple and Chas. Theis as sewer commissioners.

HUNTINGDON, PA.—Several 3×2-ft. brick sewers will very likely be constructed this summer. David S. Black, Ch. Burgess.

LOCK HAVEN, PA.—The city council has authorized the committee on streets and bridges to advertise for bids from engineers for preparing surveys and a map of the city for a sewerage system. R. D. Peck, Chn. Com.

MACON, N. C.—The city council has ordered an election for voting on the issue of bonds for a sewerage system.

JACKSON, MICH.—A committee of ten business men has been appointed to investigate the cost of a system of sewers.

ASHTABULA, O.—Bids will soon be asked for 10,804 ft. of 8 to 18-in. pipe sewers; average cut, 11 ft.; estimated cost, $22,626. H. E. Mann, Cy. Engr.

NILES, O.—Alexander Potter, C. E., New York, has been awarded the contract to prepare maps, plans and specifications for a system of sewerage and drainage for the city. A. L. Orr, Cy. Clk.

SALEM, O.—The city engineer has recommended that a sewer be constructed in Green St., to cost $20,000. The council has voted to advertise for bids for the Valley of Gehenna sewer.

STANTON, MICH.—A paper entitled "Should Stanton Have Sewerage?" was read by J. W. S. Pierson, Stanton, at the sanitary convention, held at that place April 29. A system will probably be put in.

MUNCIE, IND.—The city clerk will receive bids until May 15 for an 8 to 10-in. vitrified salt-glazed pipe sewer.

CHICAGO, ILL.—The contract for a sewer from Forest Hill to the river at 39th and Robey Sts. has been awarded to Gahan & Byrne, at $335,000. It will be a gravity sewer, and 9 ft. in diameter at the outlet.

GALESBURG, ILL.—The city engineer has prepared estimates for a sewer 5,900 ft. long to cost $30,000, and one 7,878 ft. long to cost $46,000.

WEST DULUTH, MINN.—The village engineer has prepared plans for three sewers, to cost about $45,000. These are the first of a proposed system, and it is reported that they will be constructed this summer.

FARGO, N. DAK.—The city auditor will receive bids until May 22 for the 3.5 miles of sewers referred to last week.

ST. LOUIS, MO.—The report of the sewer commission shows that the city has 360 miles of sewers, of which 27 miles were constructed last year at a cost of $115,000. An itemized request is made for $171,500 for work this year. A. N. Milner, Engr. of Sewer Dept., has completed the survey for 3,700 ft. of 20-in. iron pipe sewer to drain Harlem Creek into Ferry St. sewer. Pumps will be required for this work.

OMAHA, NEB.—The city engineer has reported a list of proposed sewers, to cost about $100,000.

HAYWARDS, CAL.—County Surveyor Nusbaumer has submitted plans for a sewerage system, which the trustees are now considering. The drainage is to be into the Bay of San Francisco, and the estimated cost, for which bonds will be issued, about $25,000.

LOS ANGELES, CAL.—Contracts for sections of the outfall sewer have been awarded to Hughes & Mayer at $10,735, and Mansfield & Grant at $77,450.

STREETS.

BRADFORD, MASS.—The board of selectmen will receive bids until May 8 for paving Main St., including edgestones and flagging.

NEWBURYPORT, MASS.—The committee on highways has voted to advertise for 5,000 tons of crushed stone for macadamizing.

SOMERVILLE, MASS.—The city engineer has recommended that Medford St. be paved with granite blocks, to cost $23,000.

DRYDEN, N. Y.—The aldermen have appropriated $20,000 for paving with brick and stone blocks.

NEW YORK, N. Y.—The department of parks will receive bids until May 10 for about 11,000 sq. yds. of macadam paving, 5,000 cu. yds. of masonry, 2,500 lin. ft. of granite coping, 10,000 cu. yds. of screened gravel, etc.

TROY, N. Y.—The contracting board will receive bids until May 9 for two contracts for paving with granite blocks.

HUNTINGDON, PA.—David S. Black, Ch. Burgess, informs us that an election will be held May 9 to vote on the issue of bonds for $50,000 for telford paving.

SOUTH BOSTON, VA.—Ford & Hughes, Lynchburg, have been awarded a contract for paving, at about $20,000.

LAKELAND, FLA.—It is reported that the work of paving the principal streets will soon be commenced.

BUCYRUS, O.—The lowest bids for paving two streets were those for Canton standard brick, as follows: Frayer & Keil, Bucyrus, $22,263 and $13,243; John Hadley, Canton, $23,091 and $14,387; Wilding & Derheimer, Fort Wayne, Ind., $23,412 and $14,665.

CINCINNATI, O.—The board of administration will receive bids until May 24 for paving with brick.

DAYTON, O.—Bids were opened April 24 for paving Third St., from river bridge to King St., from Perry

to Sears St., from Linden Ave. to Findlay St., from Perry St. to the river, and Wilkinson St. The prices per sq. yd. ranged as those for Wayne Ave., published in our issue of April 6. Some of the bids were as follows, given in the above order: Warren-Scharf Asphalt Paving Co., asphalt, $88,136, $87,875, $41,545, $35,755, $23,460; Trinidad Asphalt Co., asphalt, $86,776, $80,031, $42,054, $35,801, $23,775; M. G. Cain & Co., Medina stone, $113,100, $117,904, $54,942, $45,963, no bid; Ed. Ryan, Medina stone, $117,428, $123,473, $56,085, $45,123, $31,770.

MANSFIELD, O.—The city clerk will receive bids until May 20 for improving two streets.

SAGINAW, MICH.—It is reported that plans are being prepared for 4.8 miles of paving and 5.6 miles of sewers to be constructed this summer at an estimated cost of $255,000.

INDIANAPOLIS, IND.—Bids will soon be asked for paving five streets with asphalt; also for additional sewers.

MUNCIE, IND.—The city clerk will receive bids until May 8 for brick sidewalks.

MATTOON, ILL.—A contract for about three miles of paving has been awarded to J. G. Shea & Co., Decatur, at about $100,000.

ST. PAUL, MINN.—The board of public works has voted to pave several streets with cedar blocks. Bids will be received for paving with cedar blocks on concrete, granite blocks and asphalt.

ST. LOUIS, MO.—The board of public improvements will receive bids until May 16 for paving with Trinidad Lake asphalt.

OMAHA, NEB.—The board of public works will receive bids until May 12 for paving with asphalt certain streets upon which bids for paving with brick and stone were recently received.

ELECTRICAL.

HINGHAM, MASS.—The town clerk informs us that the town has voted in favor of putting in an electric light plant, but that a second vote will be required to secure definite action.

WINTHROP, MASS.—The selectmen have been instructed to investigate the cost of street lighting.

SUFFERN, N. Y.—The Hillburn Electric Light & Power Co. will soon begin the construction of its plant.

SHARPSBURG, MD.—Mr. Hutton, Baltimore, has submitted a proposition to light the town with electricity for $300 a year. He proposes to locate a plant at the Antietam railroad station, and extend the system to Shepherdstown, Keedysville and Boonsboro.

SALISBURY, N. C.—The city is considering the advisability of putting in a municipal plant.

WEST POINT, GA.—An electric light plant is reported as to be put in at once. Bonds for $20,000 have been voted for this and other improvements.

SHELBYVILLE, IND.—The common council will receive bids until Sept. 1 for lighting the streets with electricity for five years from July 1, 1894.

HILLSBORO, TEX.—The city has awarded a contract to the Hillsboro Water, Light & Power Co. for 20 lights of 2,000 c. p. at $100 per light per year, the plant to be in operation within six months.

NEW COMPANIES.—Gallitzin Electric Light Co., Gallitzen, Pa.; $20,000; Treas., D. S. Kloss, Tyrone. Royal Arc Electric Co., Plainfield, N. J.; $1,000,000; L. E. Howard, G. H. Squires, Plainfield, and F. C. Marsh, Elizabeth. Winchester Electric Light Co., Winchester, Ill; $14,000; William Hinsfurther, Solomon Hinsfurther, William Milhous, Washington Electric Co., Chicago, Ill.; $40,000; Victor W. Johnson, O. R. Iverson, W. J. Maddock. Metropolitan Electric Engineering Co., Chicago, Ill.; $50,000; J. Dommergue, Chas. H. Fleischer, Joseph Staab. Joplin City Light & Fuel Co., Joplin, Mo.; $150,000; C. M. Malin, S. B. and H. A. Malin.

CONTRACT PRICES.

PIPE.—Medford, Mass.—The water commissioners have awarded a contract for pipe to the Donaldson Iron Co., Emaus, Pa., at $26.24 per ton for 6 and 8-in. pipe, and $26.14 for 12-in. The McNeal Pipe & Foundry Co., Burlington, N. J., bid $28.15 and $27.65; Chas. Millar & Son, Utica, N. Y., $28.50, and the Warren Foundry & Machine Co., New York, $27.40.

Yonkers, N. Y.—Bids have been opened for the following pipe: 48-in., 6 tons; 36-in., 5; 30-in., 120; 24-in., 125; 12-in., 15; 8-in., 90; 6-in., 50; 4-in., 10; special castings, 70,000 lbs. The prices were as follows: R. D. Wood & Co., Philadelphia, Pa., $23.85 per ton of 2,240 lbs. on all pipe, and 3¼ cts. per lb. for special castings; Warren Foundry & Machine Co., New York, $26.30 and and 2½ cts.; Reading Foundry Co., Reading, Pa., $27.10 to $28.67, and 2½ cts.; Chas. Millar & Son, Utica, N. Y., $27.25 to $28.75, and 2½ cts.; McNeal Pipe & Foundry Co., Burlington, N. J., $25.25 to $27.50.

WATER-WORKS SUPPLIES.—Lancaster, Pa.—Contracts have been awarded as follows: William Wohlson, wooden stop boxes, 3½ cts. per ft.; R. D. Wood & Co., Philadelphia, Pa., iron stop boxes, $2.75 each, net, being 2 cts. per lb., and fire hydrants, 4½ ins. × 4½ ft., double hydrants, $23.50 each; John Best, Lancaster, special castings, 2 cts. per lb.; Herman Schweers, digging trenches, 17 cts. per cu. yd. for earth, and 45 cts. for rock; David Decker, hauling pipe, 35 cts. per gross ton; Enterprise Brass Foundry, ferrules, 75 cts. each; W. Parke Cummings, Lancaster, American lead, 4.7 per lb.; Mellert Foundry & Machine Co., Reading, Pa., 4-in. pipe, $27.55 per gross ton; 6, 8, 10, 12-in., $26.21; 20-in. and larger sizes, $25.76; Eddy Valve Co., Waterford, N. Y., 4-in. stop valves, $7.40 each; 6-in., $12.20; 8-in., $18.25; 10-in., $26; 12-in., $33.

Reading, Pa.—A contract for 50 hydrants has been awarded to the Michigan Brass & Iron Co., at $29.50 each, and for 40 hydrants to the Reading Foundry Co., at $30 each. The latter company has also received a contract for 6, 10 and 16-in. cast iron pipe, at $22.40 per short ton, delivered along the trenches.

BRIDGE SUBSTRUCTURE.—Bridgeport, Conn.—Bids were opened April 21 for a substructure for the East Washington Ave. bridge. The city is to drive piles and cut them in all cases, and to do capping and planking under abutments, the pivot and two resting piers to be laid in caissons furnished by the contractor. The contract was awarded to John B. Reilly & Co., the work being as follows: 1, Ashler, 793 cu. yds.; 2, backing, center-pier and abutments, 517 cu. yds.; 3, rubble masonry in retaining wall, 500 cu. yds. The prices are per cu. yd., and are as follows:

	1.	2.	3.
John B. Reilly & Co., Philadelphia	$16.00	$7.00	$6.00
P. J. Dougherty, New York	17.50	8.50	4.20
A. H. Wright & Sons, Springfield, Mass.	18.25	8 95	6.75
Connor Bros., New Haven	23 00	7.50	6.50
Pidgeon & Co., Saugerties, N. Y.	27.00	7.00	7.00
O. M. Weand, Reading	38.50	5.00	6.00
P. E. Abbott, Bridgeport	24.50	....	6.25

SEWERS.—Brockton, Mass.—We are informed by F. Herbert Snow, Cy. Engr., that the contract for laying about 16,500 ft. of 24-in. cast iron force main has been awarded to (7) Moore & Co., Boston, at $27,385, other bids being as follows: 1, Frederick E. Shaw, $37,546; 2, Chas. H. Eglee, $34,832; 3, Frank L. Allen, $32,307; 4, Thos. F. Maney and John J. Kennedy, $31,962; 5, Moulton & O'Mahoney, $28,920; 6, Daniel J. Cronin, $28,515. The prices were as follows:

	1.	2.	3.	4.	5.	6.	7.
Grubbing and clearing, 500 sq. yds., at	$4.00	$2.25	$3.00	$2.00	$1.00	$ .75	$2.50
Earth excavating, 18,000 cu. yds., at	.80	.45	.65	40	.50	.40	.40
Rock excavating, 100 cu. yds., at	7.00	5.00	5.50	4.00	5.00	9.00	4.00
Embankment, 17,000 cu. yds., at	.35	.30	.40	.40	.40	.43	.30
Distributing pipe, 1,235 tons, at	.75	1.50	3.00	1.50	.75	1.00	2.00
Laying 24-in. pipe, 16,850 ft., at	.40	.70	.25	.60	.36	.37	.30
Box culvert masonry, 280 cu. yds., at	12.00	10.00	6.00	7.00	8.00	7.00	10.00
Rubble masonry, 150 cu. yds., at	12.00	8.00	5.00	6.00	6.00	8.50	9.00
Brick masonry, 70 cu. yds., at	15.00	15.00	13.00	18.00	18.00	20.00	16.00
Concrete, 100 cu. yds., at	7.00	6.00	5.50	6.00	8.00	7.00	7.00

Monmouth Ill.—Thos. S. McClanahan, Cy. Engr., informs us that a contract has been awarded to J. D. Lynch & Co., as follows: 36-in. brick sewer, $2.60 per lin. ft.; 24-in. pipe, $1.40; 18-in., 74 cts.; 15-in., 50 cts.; 12-in., 43.5 cts; 10-in., 39 cts.; 9-in., 36 cts.; 8 and 6-in., 35 cts.; catch basins and manholes, $35 each; lampholes, $12.

STREET CLEANING.—New York, N. Y.—The following bids were received April 25 for disposing of street refuse for five years, the quantity per year being estimated at 2,500,000 cu. yds. of ashes and garbage, 625,000 cu. yds. street sweepings and 5,000 cu. yds. of material of the dock department: James McCartney, 12 to 15 cts. per cu. yd., according to place of deposit; Moffatt, Hodgkins & Clark, 23 cts. At two previous dates for receiving bids none were received.

STREET SUPPLIES.—Worcester, Mass.—Contracts have been awarded as follows: Damon Brick Co., Still River, brick, $7 per M.; F. E. Powers, Worcester, cement, 98 cts. per bbl.; Presqy Pero, manhole covers, $7.60 each, and catchbasin covers, 1¾ cts. per lb.; Webb Granite & Construction Co., catch basin stone, $9.70 per set; curbing, 45 cts. per lin. ft.; circular curbing, 65 cts.; flagstones, 18 ins. wide, 45 cts. per lin. ft.; 24 ins. wide, 65 cts.; block paving, $1.65 per sq. yd.; corners, $4 and $3 each.

GRANITE BLOCKS.—Boston, Mass.—The park commissioners have awarded a contract for 60,000 granite paving blocks to Perkins & White, at $41.25 per M.; other bids being Quincy Granite & Edge Stone Co., $41.50, and S. & R. J. Lombard, $43.50.

Washington, D. C.—Contracts for granite paving blocks have been awarded as follows: Richmond Granite Co., 150,000, at $51 per M.; A. M. Smith, 300,000, at $50; Booth Bros. and Hurricane Granite Co., 200,000, at $49, and 150,000, at $51.

Somerville, Mass.—Horace L. Eaton, Cy. Engr., informs us that the Rockport Granite Co. has been awarded a contract for granite paving blocks, 10 × 7.5 to 8 × 3.5 to 4.5 ins., at $71 per M., delivered on wharf.

BRICK PAVING.—Plattsmouth, Neb.—A. C. Mayes, Cy. Engr., informs us that a contract for brick paving has been awarded at $1.75 per sq. yd. for two courses of brick. The bid for brick on 4 ins. of concrete was $1.90.

Olean, N. Y.—F. A. Dunham, Engr. in Charge, informs us that three contracts for paving with brick have been awarded to Park, Simpson & Albrecht, as follows: Excavation, 10,300 cu. yds., 30 cts. per cu. yd.; paving 21,050 sq. yds., $1.85 to $1.95 per sq. yd.; curbing, 12,185 lin. ft., 45 cts. per lin. ft.; curbing reset, 340 lin ft., 20 cts. per lin. ft.; circular curb, 266 lin. ft., 75 cts. per lin. ft.; drain tile, 11,755 lin. ft., 10 cts. per lin. ft.; iron culvert boxes, 3 cts. per lb.

Erie, Pa.—Geo. Platt, Cy. Engr., informs us that the following lowest bids have been received for paving about 20,000 sq. yds. in 17th St., the price in the first column being per sq. yd. for brick paving alone, and the other the price including all accessories:

R. R. Jacob, Waynesburg, O.	Waynesburg Vit. Fire Brick	$1.95	$2.07
H. P. Streicker, Toledo, O.	Jno. Porter Square	2.05	2.19
" "	Jno. Porter, Repressed	2.11	2.25
" "	Jno. Porter, "Trojan" Patent	2.20	2.34
M. C. Mayer, Erie	Brady's Run, Fulton, Minerva, State Line	2.07	2.19
" " "	Jno. Porter Square	2.09	2.21
" " "	" " Repressed	2 13	2.25
" " "	Waynesburg Vit. Fire Brick	2.05	2.17
E. M. Ayres, Zanesville, O.	Jones Fire Clay	2.09	2.21
" "	Jones Block, Repressed	2.30	2.43
" "	Hallwood Block (Fire Clay)	2.55	2.68
Queen City Paving Co., Buffalo, N. Y.	Buckeye Fire Clay	2.44	2.56
I. N. Boren, Steubenville, O.	Jno. Porter Square	2.10	2.22
" " "	Jno. Porter, Repressed	2.14	2.26
" " "	Jno. Porter "Trojan" Patent	2.25	2.37

MACADAMIZING, FLAGGING, ETC.—Montclair, N. J.—The following lowest bids were received May 1: Parkhurst & Bartow, macadamized roads in four districts, 64, 66, 68, 70 or 80, 85, 87.5, 90 cts. per sq. yd. for 6 or 8-in. thick, respectively; Harper Bros., flagging, 50 or 75 cts. per lin. ft. for 4 or 5-in. wide; Thos. Wood, crosswalks, one 24-in., with 1 ft. of cobblestones each side, 78 cts. per lin. ft.; two 16-in., 1 ft. apart, and 1 ft. of cobblestones each side, 95 cts.; two 24-in., $1.15; C. E. McDowell, repairing roads in four districts, $1.90, $1.99, $1.99, $2.05 per cu. yd. for broken stone; cobble-stone gutters, 7¾ cts. per sq. ft.

MISCELLANEOUS.

LOCK AND DAM.—Charleston, W. Va.—Bids were opened by Col. W. V. Craighill, U. S. Engineer Office, April 25 and 26, for building locks and dams Nos. 10 and 11 of the Great Kanawha River improvement, the lowest being Zimmerman, Traux & Sheridan, Duluth, Minn., $232,441, and Thos. Munford, Lock Seven, $526,895, respectively. The total bids and the itemized prices of dam No. 11 received at a previous opening of bids were published in our issue of March 16.

BULKHEAD AND DOCK.—Plans and specifications for a combination crib bulkhead and pile dock, 200 × 75 ft., for the joint use of the Oscawana & Cornell R. R. and the Iron Steamboat Co., have been completed, to be built at Oscawana Island. Estimates are asked at the company's office, 44 Pine St., New York, and information can be obtained from James S. Haring, Ch. Engr., Oscawana, N. Y.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Rhode Island Locomotive Works, Providence, R. I., have built 3 two-cylinder compound express engines for the Chicago, Milwaukee & St. Paul, to run between Chicago and Milwaukee; the works have also an order for two-cylinder compound ten-wheel engines for the Minneapolis, St. Paul & Sault Ste. Marie. The Brooks Locomotive Works, Dunkirk, N. Y., have shipped the first of a large order of ten-wheel passenger engines for the Great Northern. The Roanoke Machine Works, Roanoke, Va., have delivered three freight engines to the Norfolk & Western. The Baldwin Locomotive Works, Philadelphia, Pa., have an order for 6 ten-wheel passenger engines and 2 six-wheel switching engines for the Seaboard Air Line, and for 4 passenger engines for the New Orleans & Northeastern. The Chicago Great Western will add 20 freight engines and 5 passenger engines to its equipment.

CARS.—The Michigan Peninsular Car Co., Detroit, Mich., is building 1,500 coal cars of 60,000 lbs. capacity, with Westinghouse brakes and M. C. B. couplers, for the Columbus, Hocking Valley & Toledo. The St. Charles Car Co., St. Charles, Mo., has an order for 1,000 coal cars for the Wabash, and another for 300 stock cars for the Union Pacific. The Harrisburg Car Mfg. Co., Harrisburg, Pa., is building 300 freight cars. The Jackson & Sharp Co., Wilmington, Del., has an order for narrow gage freight cars for Colombia.

DUMP CARS.—Several dump cars are wanted by the Weston Mfg. Co., Weston, W. Va.

RAILS.—The Lackawanna Iron & Steel Co. has an order for 15,000 tons of steel rails for renewals on the New York Central. The Maryland Steel Co. has an order for 100-lb. rails for the New York, New Haven & Hartford R. R.

SEWER PIPE.—The Great Western Fire Clay Co., Toronto, O., will erect new buildings and plant for the manufacture of large-size sewer pipe.

PUMPS.—Henry R. Worthington, New York, has a contract from the American Sugar Refinery Co., at Brooklyn, for two pumping engines of 7,000,000 gallons capacity.

THE RIEHLE BROS. TESTING MACHINE CO., Philadelphia, Pa., will have an interesting exhibit in the Machinery Building at the World's Columbian Exposition. Among other articles they will exhibit a 300,000-lb. vertical screw power testing machine with patented electric automatic screw beam; 200,000-lb. horizontal car coupler testing machine arranged for links, pins and brakebeams; 200,000-lb. vertical screw power testing machine, and 100,000-lb. similar machine with electric automatic beam; 80,000-lb. spring testing machine; 20,000-lb. vertical screw power testing machine with vernier poise; 20,000-lb. horizontal band tester; 5,000-lb. and 3,000-lb. transverse testing machines with indicator; 5,000-lb. torsional testing machine; 1,000-lb. cement testing machine, with worm gear and rubber grips (the style used by the U. S. Government); also cloth and twine testing machines. The company will also show its latest improved patented marble molding and countersinking machine. The exhibit is in charge of Mr. J. R. Matlack. At the Government Building—in the Government exhibit in charge of Capt. A. H. Russell—will be found a Riehle 200,000-lb. vertical screw power testing machine; and in the Quartermaster's Department in the Government Building a 200-lb. cloth testing machine. These were loaned by the company. The Riehle-Robie patented frictionless ball-bearing screw jacks will be found in the government exhibit, as well as in the company's exhibit.

R. C. POPE, Chicago, reports ten of his road rollers in use in Chicago, and several recent orders from that and other cities.

JOHN MASLIN & SON, Jersey City, N. J., state that they are presenting to every user of a pulsometer pump one of their improved air valves. The valve can be reground or repaired without removing from pump; can be adjusted while the pump is working, and admits finer adjustment than other air valves.

THE PELTON WATER WHEEL CO. reports an active business in wheels and motors both from San Francisco and the New York branch. Among the recent installations are the San Antonio and the Redland light and power plants, both in California. These plants are important on account of the long distance the power is transmitted, being 28 and 12 miles respectively. The new system of regulation perfected by this company adds particular value to the wheels for all classes of electric service, and the company is now making the wheels completely inclosed in iron cases. Two of this class have recently been shipped to Chicago to operate in connection with the General Electric and Westinghouse mining exhibits. The company has also supplied the motors used on the system of the Hydraulic Power Co., London, which has extensive pipe lines under a pressure of 700 lbs. per sq. in.

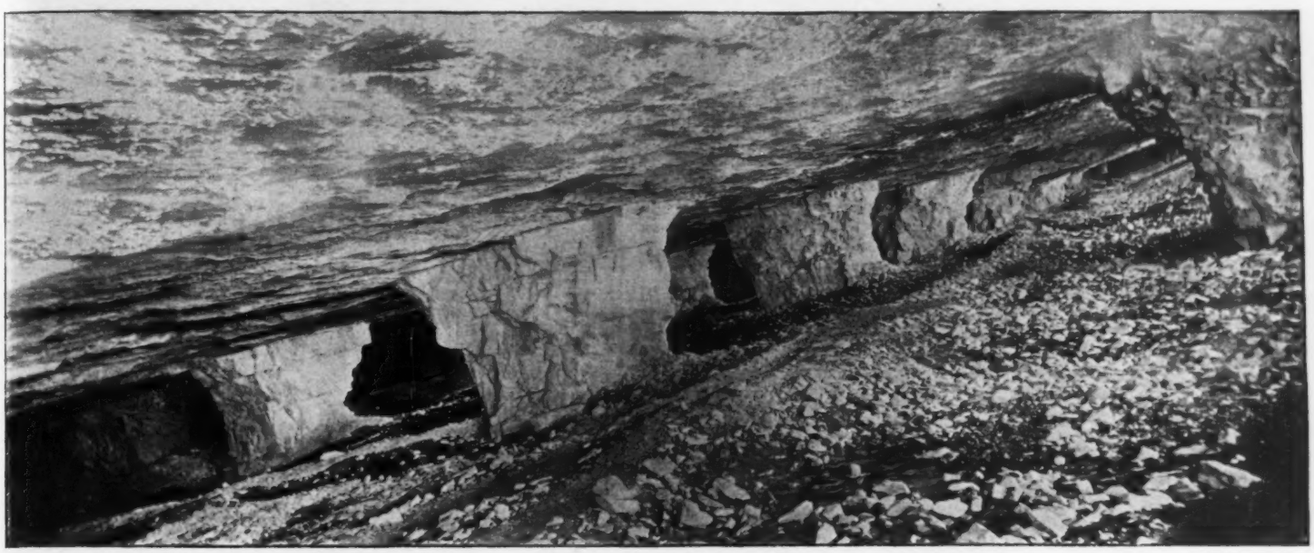
NEW COMPANIES.—Interstate Brick & Tile Co., East St. Louis, Ill.; $1,000,000; P. A. Griswold, G. A. Taylor and George Shone. Meigs Railway Construction Co., Charleston, W. Va.; $3,000,000; J. V. Meigs, W. J. Dennett and George H. Towle, all of Boston, Mass. Mascotte Iron Co., Chicago, Ill.; $1,000,000; L. D. Toman, W. S. Oppenheim and W. S. Holden. Gogebic Furnace Co., Milwaukee, Wis.; $500,000; L. M. Bean, W. H. Cottrill and W. H. Allis. Neeb Grading & Contracting Co., Milwaukee, Wis.; $2,000; E. J. Neeb, F. W. Henderson and S. Henderson.

INDUSTRIAL SUPPLEMENT TO ENGINEERING NEWS.

NEW YORK, MAY 4, 1893.

THE MANUFACTURE OF "HOFFMAN" ROSENDALE CEMENT.

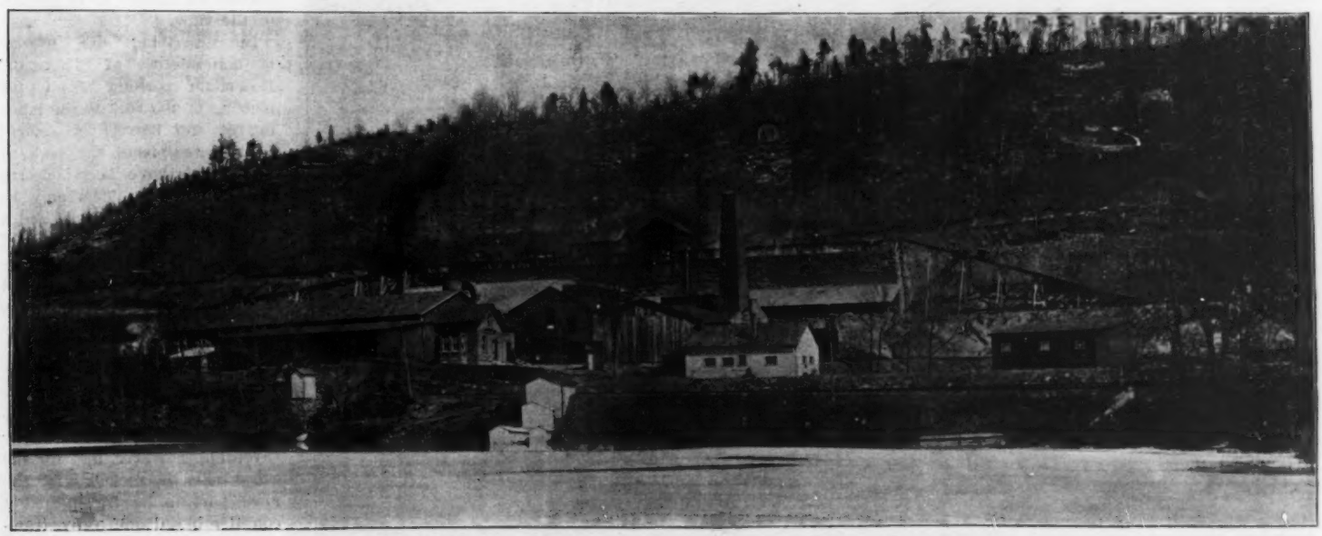
In 1823, while building the Delaware & Hudson Canal near the village of Rosendale, Ulster County, New York, the fact was discovered that the dark blue limestone rock through which the canal was being excavated, possessed hydraulic properties, and, upon proper calcination, would produce a powerful hydraulic cement. About ten years later, or in 1832, Watson E. Lawrence built a few small kilns, opened a mill, and began the manufacture of the "Lawrence" brand of Rosendale cement at Lawrenceville, on the banks of Rondout Creek, not far from the village of Rosendale. This mill, which has long since been closed, was operated by water-power from the creek, and was capable of producing 20 barrels of cement per day. The growth of the company's works since the opening of the Lawrenceville mill has been in proportion to the enormous growth of the Rosendale cement industry in this country. The present mills of the Lawrence Cement Co. produce 5,500 barrels of cement per day and about 1,000,000 barrels per year, or about one-third of the Rosendale cement manufactured in Ulster County, and about one-eighth of the total amount manufactured in the United States.



INTERIOR OF CEMENT ROCK QUARRY.

Briefly summarized, the company's works consist of four mills, located at Binnewater, Rock Lock, Eddyville, and Esopus. The mill at Esopus, although in full working order, is not being operated, but the other three are grinding the rock from 64 kilns, and producing, as before stated, 5,500 barrels of cement per day. The respective capacities of the three mills in operation are: 2,000 barrels, 1,200 barrels, and 2,300 barrels of cement per day. In connection with each of the cement mills proper are storehouses, cooper shops, repair shops, power houses and offices, and, in addition, all the cableways, tramways, and hoisting apparatus necessary in handling both the cement rock and the barrels and bags of manufactured cement.

The source from which the Lawrence Cement Co. derives its supply of cement rock is the well-known tentaculate or water limestone, belonging to the great natural cement rock formation extending along the Appalachian Mountains from Vermont to Virginia. In Ulster County the deposits are mostly found within the limits of a narrow belt, scarcely a mile wide, skirting the base of the Shawangunk Mountains, along the line of the Delaware & Hudson Canal, in the valley of Rondout Creek. Owing to a succession of upheavals, of which the whole region exhibits remarkable evidences, the beds, or strata, of cement rock are found in almost every conceivable inclination to the horizon, but ordinarily dipping in a greater or less degree to the northwest or southeast. The useful effect of these upheavings has been to raise into accessible and convenient positions the cement rock which would otherwise have been buried beyond practicable

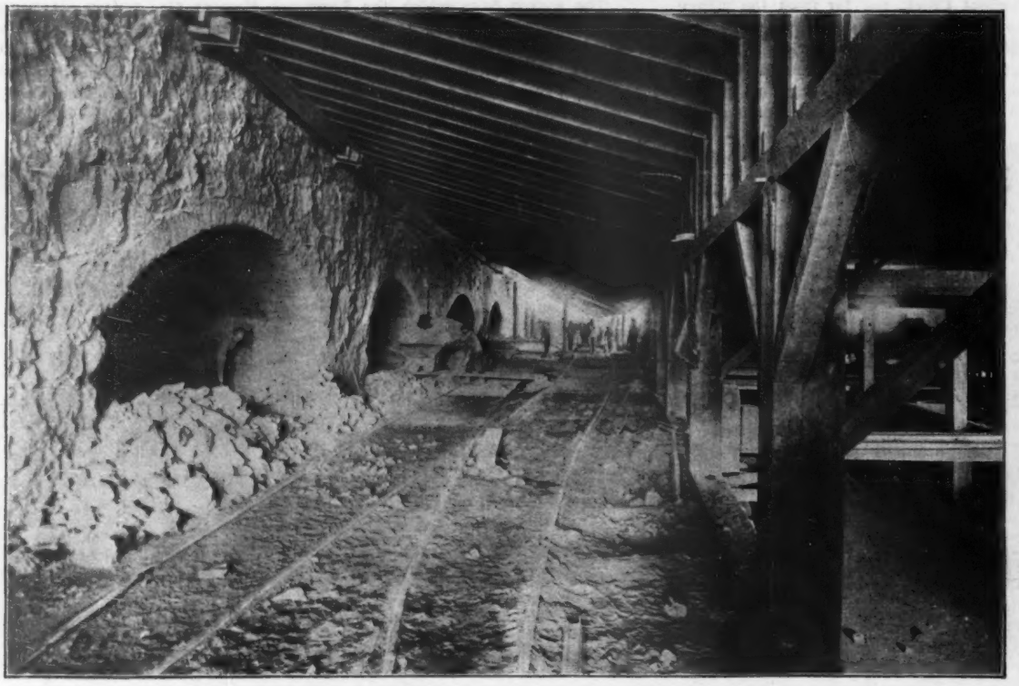


THE BINNEWATER MILLS OF THE LAWRENCE CEMENT CO., ULSTER CO., N. Y.

reach for manufacture. As it is, the outcropping strata are worked by open quarrying.

The rock used in the manufacture of "Hoffman" Rosendale cement is taken from two beds separated by a sandstone rock known as the "middle rock." The upper of these beds is known as the "light rock," and the lower as the "dark rock," and the two are mixed together in the proportion found to give the best results for the different quarries. These quarries are carried into the hills to various depths, following always the layer of cement rock. In the quarrying power drills are used, and the explosives employed are dynamite and black powder. Some idea of the extent of these quarrying operations may be gained when it is considered that in 1892 there were used 62,000 lbs. of dynamite, 350 kegs of black powder and 175,000 ft. of blasting fuse. After blasting, the rock is broken into pieces varying from the size of an orange to that of a football, loaded onto tram cars and taken to the kilns for burning. The appearance of a quarry after the excavation of the cement rock is very clearly shown in the first photographic view. Here it will be seen that all of the cement rock within sight, excepting the pillars left to support the roof, has been excavated, and quarrying operations are now being carried on further in to the left of the view.

KILNS AT HICKORY BUSH.

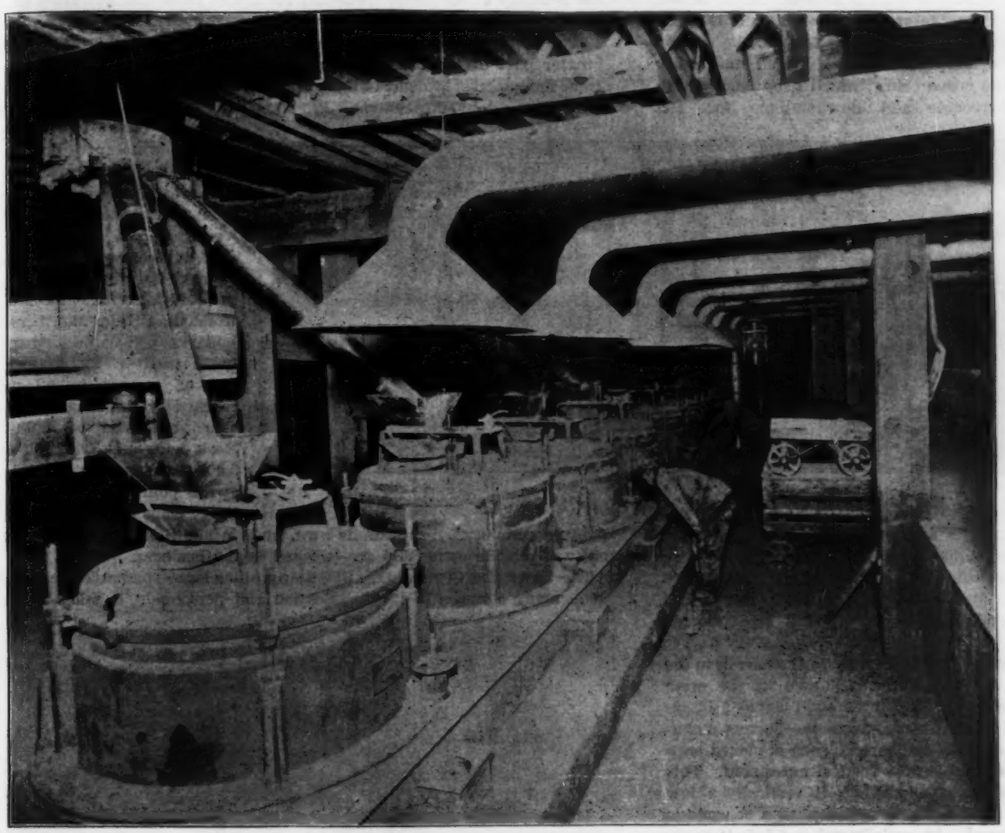


BOTTOM OF KILNS WITH CRACKER ROOM TO THE RIGHT.

In describing the process of manufacture of "Hoffman" Rosendale cement, from the blasting of the rock to the labeling of the barrels of cement ready for shipment, the works at Binnewater have been selected for illustration. This may be taken as a typical plant, and a description of the process of manufacture as carried out here will apply equally well, except in minor details, to any of the company's other plants. At the Binnewater plant, illustrated in the second photographic view, the quarries are located in the ridge directly to the rear of the mills. This location is unusually favorable, however, and for the other mills the rock has for the most part to be transported a considerable distance by tramway. In several instances, also, the kilns are located at some distance from the mills, and the burned rock has to be conveyed to the mills in tram cars. After the excavation and breaking of the rock it is conveyed to the kilns, and, by means of a track passing over their tops, is dumped directly from the cars to convenient points for charging them. In the second photographic view, showing the Binnewater plant, the location of the kilns to the rear of the mills is shown, and in the third view are shown the kilns at Hickory Bush supplying the Eddyville mill.

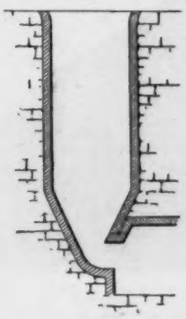
The process of calcination is very simple, in as far as not requiring an

elaborate apparatus is concerned, but it requires constant watchfulness and care; a thorough knowledge of the effects of the temperature and of the velocity and direction of the wind, and perfect familiarity with the characteristics of the different classes of rock. In other words, the personal element enters largely into the process, and, as the quality of the cement depends in a great degree upon the care taken in the calcination,



GRINDING ROOM.

it is important that only men of experience and skill should be employed as burners. The kilns are built of stone and lined with brick, and the calcination is carried on by placing on the top a



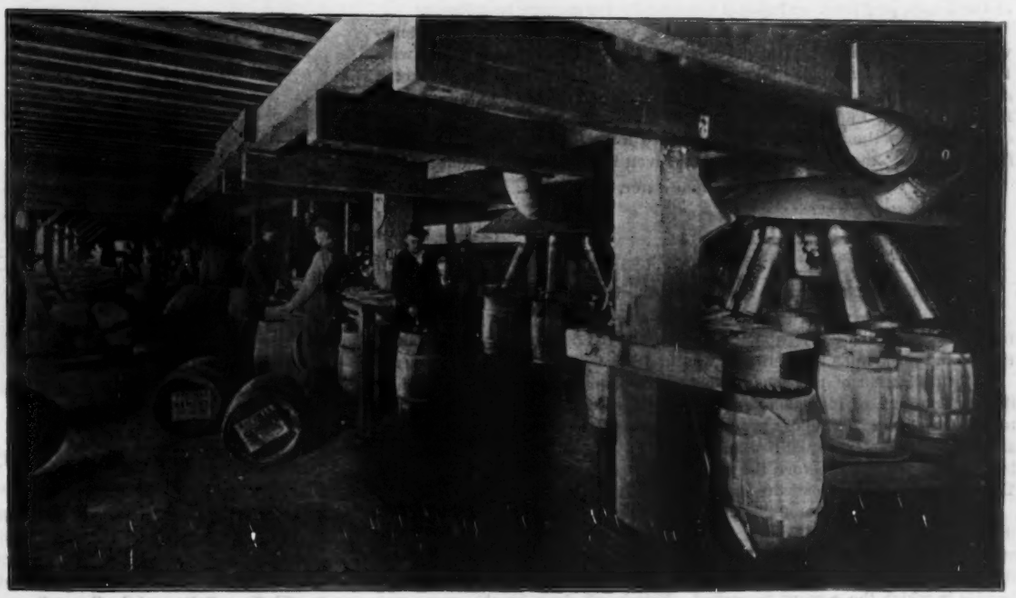
KILN.

layer of stone from 6 ins. to 8 ins. thick, and then a thin layer of coal, and repeating the process as often as the removal of the calcined rock at the bottom requires it. The coal used is anthracite, usually of pea or buckwheat size, and is placed on the rock in very thin layers, scarcely covering it. Each morning the previous day's burning is removed from the bottom of the kilns, as by this time the rock has become sufficiently cool to be handled. In drawing the kilns it is always found that some of the rock has been much over-burned, in fact, having reached a stage of incipient vitrification, while another portion, consisting usually of the larger fragments, is under-burned and perhaps partially raw inside. The over-burned stone is, of course, quite worthless, and is carted away to the dumps, but the under-burned stone is conveyed to the tops of the kilns, and again subjected to calcination.

From the bottoms of the kilns the stone, which has been properly calcined, is taken directly to the cracker-room. In the fourth view, showing the draw pits of the kilns at Binnewater, this cracker-room is just across the tramway tracks, and is partly shown at the right hand. In the cracker-room the rock is crushed to a fineness varying from dust to lumps of the size of a hickory nut, by what are known as crackers. These are made of cast iron, and consist essentially of a frustum of a solid cone called the core, work-

CRACKER.

ing concentrically within the inverted frustum of a hollow cone, both being provided on their adjacent surfaces with suitable grooves and flanges for breaking the stone as it passes down between them. The elements of the lower portions of both cones make a smaller angle with the common axis than those pertaining to the upper portions, with a view to lessen the strain and the effects of sudden shocks upon the machinery, by securing a more gradual reduction of the stone to the required size. These lower portions being subject to very rapid wearing, are made of chilled iron, and are, moreover, cast in separate pieces in order that they may be replaced by new ones, as the occasion requires. At the Binnewater mill there are eight of these crackers driven by steam power, which, it may be stated here, is used in all of the company's mills, both for driving the mill machinery proper and for running the various hoisting engines.



PACKING ROOM.

After being crushed in the crackers the broken stone is conveyed by chutes directly to the grinders, which look as nearly as possible like the stones in an ordinary grist mill, as will be seen from the illustration of the

grinding room. In fact, the grinding of cement is exactly like the grinding of corn. The Shawangunk conglomerate, or grit, which is found in large quantities in Ulster County, is used for the millstones. At Binnewater there are 14 grinders, or, in other words, 14 pairs of millstones, and they grind sufficient rock to make 2,000 barrels of cement per day. The grinders are placed in a single row and discharge into boxes containing screw conveyors, which run from each end to the center. The ground cement is thus conveyed from each grinder to a central reservoir, from which it is taken by a bucket conveyor to the mixers. By means of the mixers, the cement coming from the separate grinders is thoroughly mixed, and uniformity of quality is secured. To remove the cement dust, which rises thickly from the grinders, and is both disagreeable and unwholesome for the

COOPER SHOP.

workmen, a powerful ventilating fan is used. This fan draws the dust through the pipes shown with funnel shaped openings over each grinder, in the view of the grinding room, and conveys it to the floor above, where it is separated from the atmosphere, and deposited to be put in barrels and sold. About one and one-half barrels of this cement dust are collected every day at the Binnewater mill.

From the mixers the cement passes by chutes directly to the barrels in the packing-room. The packing-room at Binnewater is shown in the sixth photographic view. The metal pipes in the right foreground connect directly with the mixer, and, as will be seen, discharge into the barrels underneath. To settle the cement thoroughly in the barrels, each is placed on a circular iron disc or table, which is capable of a vertical movement. This disc is connected with suitable machinery which lifts it vertically a few inches, and then suddenly releases it, allowing it to fall with a concussion which settles the cement in the barrel. As each barrel is filled, it is removed to the scales, where a man removes or adds sufficient cement to bring the weight exactly to 300 lbs. The barrels then pass to men who put in the heads, and label and stamp them ready for storage or shipment.

As stated before, steam power is used for operating the mills. At Binnewater five boilers supply steam to a pair of Corliss compound engines, with the high pressure and low pressure cylinders mounted tandem, driving a single shaft. The cylinders are 24 ins. × 48 ins. and 44 ins. × 48 ins. At the Rock Lock and Eddyville works the Wm. Wright engines are used. In order to bring the equipment of the three mills into convenient position for comparison, the principal details are given in the following table:

	Binnewater.	Rock Lock.	Eddyville.
No. of kilns	23	17	24
No. of crackers	8	4	8
No. of grinders	14	8	16
No. of packers	8	8	16
Daily capacity	2,000 bbls.	1,200 bbls.	2,300 bbls.
Storage capacity	15,000 bbls.	9,000 bbls.	25,000 bbls.

In addition there are at the Esopus mills two crackers, four grinders and four packers, with a daily capacity of from 600 to 800 barrels. The production of the three mills in operation was in 1892, 969,400 barrels of cement.

As an indication of the conscientious care displayed by the company in the manufacture of its cement may be mentioned the thorough system of tests carried out. The daily product is subjected to an examination as regards fineness, setting qualities and strength. Not only is this done every half hour of the day before the cement leaves the mills, but in the New York office laboratory tests are made of each day's grinding.

In this brief statement of the process of the manufacture of cement by the Lawrence Cement Co., it will be noticed that the manufacture of supplies for the mills forms industries of very respectable magnitude in themselves. The most noteworthy of these is the manufacture of the barrles in which the cement is packed. This is all done by the company; cooper shops, being located at each of the mills. At these shops are facilities for manufacturing the barrels complete, lining them with paper and storing them for use. The raw materials, hoops, staves, heads, etc., are stored in and about the mills. At Eddyville the company has a large boat yard, where repairs are made to its fleet of boats, about 25 of which are used to transport the cement on the canal and down the Hudson River. In addition, at each mill blacksmith and carpenter shops are located where repairs are made to the drills, tram cars, and tools used in the quarries and about the mills.

A very important factor in an industry requiring frequent shipments of cargoes of large bulk and weight is, of course, the proximity of transportation lines to the center of production. It is a somewhat curious, and, withal, very important fact that nearly all of the present cement rock quarries were discovered while constructing the great waterways in the early part of the century, and the first use of the cement manufactured was in the masonry of the locks, walls and bridges of these canals. The construction of the Delaware & Hudson Canal first disclosed the cement rocks of Ulster County, and it now furnishes the means of transportation for the greater part of the cement manufactured by the Lawrence Cement Co. from the quarries brought to light in its construction. Not all of the cement manufactured by the company is shipped by the canal, however. The company has two shipping points, viz., at Binnewater and Eddyville. At Binnewater the works are located within a few rods of the Wallkill Valley R. R., and all of the cement manufactured here is shipped by railway. The works at Eddyville are located on Rondout Creek, and here are built extensive docks for the boats used in the transportation of cement to all points reached by the canal and river. The production of both the Rock Lock and Eddyville mills, 3,500 barrels daily, is shipped at this point. In this canal and river transportation the company has about 25 boats of its own, and, in addition, a large number of craft of outside ownership are engaged in the business.

The Lawrence Cement Co., like many other large companies, has undergone many changes in its organization and personnel. It takes its name

H. McMurtry

from Watson E. Lawrence, who first began the manufacture of the "Lawrence" cement in the little mill at Lawrenceville. Later the Lawrence Cement & Manufacturing Co. was organized and the works extended, and in 1853 the name of the brand of cement manufactured was changed to "Hoffman" Rosendale Cement.

Mr. Ernest R. Ackerman is the president of the company, and the vice-president and general superintendent is Mr. Henry McMurtry. Mr. McMurtry, whose portrait is given, is of Scotch descent, his ancestors coming to this country in 1740. Before occupying his present position he was engaged in cotton manufacturing at New Brunswick, N. J. Mr. McMurtry has been with the Lawrence Cement Co. since 1885, and has full charge of the works. The other officers of the company are Mr Thomas A. Smith, secretary, and Messrs. M. Albert Scull and Marion S. Ackerman, general sales agents.

PROPOSALS FOR NEW WATER SUPPLY.

Sealed proposals will be received at the office of the Board of Commissioners of Water-Works of the city of Galveston, Tex., until twelve (12) o'clock, m., of the 8th day of May, 1893, for furnishing the city of Galveston with the material and for performing the work outlined in the following approximate amounts:

About 13,117 tons of 2,000 pounds of 30-inch cast iron water pipe.

About 2,177 tons of 2,000 pounds of 30-inch special cast iron water pipe for submerged pipe line.

About 33 tons of 2,000 pounds of miscellaneous cast iron pipe.

About 60 tons of 2,000 pounds of assorted special casting.

About seventeen 30-inch valves; four 36-inch valves and about forty-six valves of other and smaller sizes.

One stand-pipe, 48 inches in diameter by 40 feet high.

One valve well about 18 feet by 20 feet, and 20 feet deep, with house.

One reservoir, 40 feet inside diameter; with house.

One artesian well system, guaranteed to supply 5,000,000 gallons of water per twenty-four hours.

Laying about sixteen miles of pipe on land.

Laying about two miles of 30-inch submerged pipe.

Erecting one pumping station 40 feet by 80 feet.

Furnishing and erecting on foundations two pumping engines, each of 6,000,000 gallons capacity per twenty-four hours, with boilers.

The work must be completed within twelve months from date of contract. Plans can be seen at the office of the Chief Engineer to the Board of Commissioners of Water-Works.

Printed specifications can be had from the City Clerk or Chief Engineer.

The right is reserved to reject any or all bids.

Bids to be for the whole work and for the different divisions of the work, separately, as per specifications.

Proposals must be made upon blank forms attached to specifications, and accompanied by guarantee bond and the sum of $5,000 in cash on the whole, or a proportionate amount on the different subdivisions of the work, as an evidence of good faith; said amount to be forfeited to the city on failure of bidder to enter contract.

Proposals will be indorsed "Proposal for New Water Supply," and must be addressed to A. S. NEWSON, Chairman of Joint Committee on Water Supply.

A. S. NEWSON,
ROBERT HAYES,
GEO. F. SCHNEIDER, JR.,
J. C. SMITH,
WM. REPPEN,
P. N. HARRIS,
L. SCHMIDT,
JOHN WEGNER,
Joint Committee on Water Supply.
W. KIERSTED, Engineer. 15-4t

TO CONTRACTORS FOR SEWER CONSTRUCTION.

CITY OF BROCKTON.

Office of the Sewerage Commissioners,
(Seal.) Room 27, Home Bank Block.

Sealed proposals will be received at this office until 12 o'clock, noon, May 11th, 1893, for furnishing all labor and a portion of the material necessary for the construction of about 10,500 feet of brick sewers, ranging in size from 26 × 39 ins. to 32 × 48 ins., egg-shaped, together with all appurtenant structures. Plans, specifications, and form of contract, may be seen at this office, or will be furnished on application to F. Herbert Snow, City Engineer, Brockton, Mass.

The Commissioners reserve the right to reject any and all bids.

R. P. KINGMAN,
H. A. MONK,
A. C. THOMPSON,
Sewerage Commissioners.
F. HERBERT SNOW,
City Engineer. 17-2t

HERKIMER SEWER WORK.—NOTICE TO CONTRACTORS.—Sealed proposals will be received by the Board of Sewer Commissioners of the Village of Herkimer, N. Y., by the Clerk of the Sewer Commission, at the Trustees rooms, of the Village of Herkimer, N. Y., until 12 o'clock, noon, Tuesday, May 9th, 1893, for furnishing material, and constructing and completing a system of sewerage in and for the Village of Herkimer, N. Y., according to plans and specifications furnished by F. K. Baxter, Civil Engineer, and approved by the State Board of Health March 15, 1893. Specifications, forms of proposals and forms of contract will be furnished from and after April 25th, 1893, from and after which date all the necessary detail drawings can be seen at J. Horatio Huyck's office on Main Street, Herkimer, N. Y. Bids will be received both in the aggregate and in detail, at the option of the bidders. The Sewer Commissioners reserve the right to make such modifications as they may choose after receiving bids for same. The right to reject any or all bids is hereby reserved.

O. H. PERRY,
President.
J. H. HUYCK,
I. O. NELLIS,
J. D. HENDERSON,
A. C. DEVENDORF,
Sewer Commissioners.
CHAS. R. HELMER,
Clerk.
F. K. BAXTER,
Chief and Consulting Engineer. 18-1t

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica, N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

JOHN W. HARRISON, Pres. and Treas. THOS. HOWARD, Vice-Pres.
F. B. NICHOLS, 2d Vice-Pres. E. H. QUEEN, Sec'y. P. MCARTHUR, Supt.

HOWARD-HARRISON IRON COMPANY,
MANUFACTURERS OF

CAST IRON PIPE

FOR WATER-WORKS, GAS WORKS, CULVERTS.
Pipe and Pump Connections. Flexible Joints. Heavy Loam Castings.
Works at BESSEMER, ALA. Offices at BESSEMER and ST. LOUIS.

ARTHUR KIRK & SON, PITTSBURGH, PA.

POWDER, DYNAMITE, ROCK DRILLS,
AIR COMPRESSORS, ROCK BREAKERS,
Safety Fuse, Electric Batteries, Miners' Squibs.

FOR Best Results USE THE WARREN FILTER,
—MANUFACTURED BY—
CUMBERLAND MFG. CO., Boston, Mass.

THE STANDARD CONSTRUCTION CO.,
GENERAL CONTRACTORS.
SEWER AND MASONRY BUILDING, STREET PAVING, ETC.
Main Office, Lewis Block, Pittsburg, Pa.

The Only Practical Solution of the high service difficulty is the Lang High Service Motor

Now in successful operation at New London, Conn., and Burlington, Vt. See ENGINEERING NEWS, issue of Jan. 19, 1893, for details. Absolute economy, highest possible efficiency. **Guaranteed.** Correspondence solicited.

LANG & GOODHUE MFG. CO., Hydraulic Engineers,
BURLINGTON, VT.

Smoothness of motion, absolute safety and high speed are among the good qualities possessed by OTIS ELEVATORS. They are built by Otis Brothers & Co., 38 Park Row, New York.

SEWERS, FLUSHING, N. Y.

Proposals to construct in Myrtle Avenue and certain abutting streets, in the Village of Flushing, about 9,500 feet of pipe sewers, ranging in size from nine inches to twenty-four inches, will be received by the Board of Trustees of the Village of Flushing, at their rooms in the Town Hall, until 8 p. m. on the 10th day of May, 1893.

For specifications and information apply to G. A. ROULLIER, Village Engineer, at No. 20 Main Street, Flushing, L. I.

A certified check in the sum of two thousand dollars must accompany each bid.

The right is reserved to reject any or all bids.

By order of the Board of Trustees.
17-2t CLINTON B. SMITH, Clerk.

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received by the Sewer Commissioners of the Village of Fort Plain, N. Y., until Saturday, May 13th, 1893, at 2 p. m., for the construction of a system of sewers in said village. Each bid must be accompanied by a certified check for the sum of $500, drawn to the order of the President of the Board. The Commissioners reserve the right to reject any and all bids.

Plans and specifications may be seen at the office of the Clerk of the Board, or at the office of the Engineer.

DOUGLAS AYRES, Pres.
EDWARD ALLEN,
WILLIAM CLARK,
DAVID E. DUNN,
D. G. HACKNEY,
Sewer Commissioners.
JAMES A. WENDELL, Clerk.
DEWITT C. SMITH, Engineer.
Schenectady, N. Y. 17-2t

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received at the Town Clerk's office, East Providence, R. I., until Tuesday, May 16, at 2 p. m., for the construction of 1,800 feet of 36-inch to 20-inch brick sewer, and 1,600 feet of 15-inch to 6-inch pipe sewer, with manholes, catch-basins, and connections. Plans and specifications can be seen at the office of the Engineer, No. 1 Ray's Block, East Providence. The Town Council reserves the right to reject any and all bids.

GEORGE F. HUNTER, Town Clerk.
W. M. DEXTER, Engr. 18-2t

COMMONWEALTH OF MASSACHUSETTS METROPOLITAN SEWERAGE COMMISSIONERS—NOTICE TO BUILDERS OF PUMPING ENGINES.—Sealed

bids for the pumping plant for the Metropolitan Sewerage pumping station at East Boston, and sealed bids for the pumping plant for the Metropolitan sewerage station at Deer Island, will be received by the Board of Metropolitan Sewerage Commissioners at its office, 110 Boylston Street, Boston, Mass., until 12 o'clock m. of Saturday, May 27, 1893, and at that time will be publicly opened and read.

The Board will provide at each pumping station, an engine house, boiler house, chimney and masonry foundations for the pumps, and will furnish a fresh-water supply for the boilers up to the interior of the boiler house. The contractor's bid for each plant must be for furnishing, setting up, and completing, ready for use, two pumping engines (or sets of engines), four boilers, piping and all necessary appliances and fittings such as are to be found in pumping stations of the best class.

Each pumping engine must be capable of easily raising 70 cubic feet of sewage per second 19 feet vertically above the level of the sewage in its respective pump-well. Each of the engines must also be capable of raising to greater lifts up to 25 ft. quantities of sewage inversely proportional to such lifts.

Each engine must also be capable of pumping at as low a rate as 15 cubic feet per second, and at all rates between 15 and 70 cubic feet per second.

The foregoing capacities must be demonstrated by suitable trials.

Each bidder must state in his bid the duty he will guarantee for each engine in the duty trials outlined in the general specifications:

Table of Some Approximate Working and Trial Data, Etc.

	Deer Island.	East Boston.
Elevation of the surface of the sewage in the pump-well above datum....(Varies from	Feet. 94.0	Feet. 90.8
to	101.4	93.5
Elevation of the bottom of the pump-well is assumed to be..	85.5	80.0
Elevation of the surface of the sewage in the discharge channel above datum.(Varies from	101.0	105.3
to	120.0	112.5
Least lift.....	6.0	14.5
Average lift.....	11.0	15.0
Ordinary maximum lift.....	18.6	19.0
Lift during duty trial at rate of 70 cu. ft. per sec.....	11.0	15.0
Lift during capacity trial at rate of 70 cu. ft. per sec...	19.0	19.0
The elevation of the boiler house floor should be not lower than.....	116.5	116.5

The elevations mentioned above are referred to a datum about 100.64 feet below mean low water of Boston Harbor.

The contractors must provide at each station four steam boilers of such capacity that any three of them can easily supply the necessary steam for the two engines when discharging together 140 cubic feet per second with a lift of 19 feet.

Plans will be furnished by the Board showing the position of the engine houses and the in-coming and out-going sewers at East Boston and Deer Island.

The first pumping engine at each station, and at least two boilers at each station, must be set up, ready to run, before May 31, 1894; the remaining engine, boilers and other appliances before Aug. 31, 1894. A third pumping engine and additional boilers will probably be called for at each station within a few months thereafter, and a fourth engine and additional boilers may be needed in the future. The third and fourth engines and their boilers are not now to be bid for. The arrangement of the plant, however, must be such as will not interfere with the above named extension.

The design of the pumping engines may be of any form which will fulfill the required conditions of the general specifications.

Each bid must be accompanied by drawings showing clearly the size and arrangement of the steam cylinders, pumps, boilers and all other parts of the mechanism and must also show the necessary details for the engine foundations, which are to be provided by the Board.

The specifications, which must also accompany the bid, must give the kind and the quality of the materials of which the various parts are to be composed, the size and the strength of the principal working parts, and the manner in which they are to be constructed, so as to furnish a clear understanding of all points regarding the workmanship, strength, durability, general efficiency of and space occupied by the whole mechanism and plant.

Each bid must be inclosed in a sealed envelope indorsed "Proposal for Pumping Plant for the Metropolitan Sewerage Pumping Station at East Boston" or "Proposal for the Pumping Plant for the Metropolitan Sewerage Pumping Station at Deer Island," and be delivered to the Board or to its clerk.

Each bid must be made on one of the blank forms furnished by the Board, and must be accompanied by a properly certified check for the sum of $1,000, the latter to be returned unless forfeited by the abandoning of the proposal.

The Board reserves the right to reject any and all bids.

Plans, blank forms, general specifications and further information may be obtained at this office.

HOSEA KINGMAN,
TILLY HAYNES,
HARVEY N. COLLISON,
Board of Metropolitan Sewerage Commissioners of Massachusetts.
HOWARD A. CARSON,
Chief Engineer. 13-9t

TO SEWER CONTRACTORS.

The Board of Public Works and Affairs of Nashville, Tenn., will be prepared to receive bids until 3 o'clock p. m., Tuesday, May 16th, 1893, for constructing sections A, B, C, D and E of the Lick Branch Sewer, and all necessary connections and incidental work.

Contractors may bid on any or all sections; but if more than one section is bid on, the bids must be separate.

The said Board reserves the right to reject any or all bids, and to award the contract as a whole, or in such portions as the interest of the city requires or to award any contract for any section, and to reject all other bids.

All bids must be accompanied by a certified check, payable to the order of the Board of Public Works and Affairs, in the sum of $1,000 for each section of said work bid upon. This check (or checks) to be forfeited by any bidder to whom any bid is awarded and who shall thereafter refuse to enter into a contract to do the work so awarded.

Specifications and drawings can be examined at the City Engineer's office.

Bidders are informed that, according to the act of the Legislature of 1893, no bidder shall employ convict labor in the said work or any part of it.

By order of the Board of Public Works and Affairs. J. A. JOWETT,
16-4t City Engineer.

PROPOSALS FOR FREE BRIDGE.

Notice is hereby given that the undersigned will, on June 5, 1893, at the office of the County Judge of Pulaski County, receive plans and working specifications for building a bridge across the Arkansas River at Broadway Street, in the city of Little Rock, reserving the right to reject any and all plans and specifications. No plans and specifications will be paid for unless finally accepted.

This 27th day of April, 1893.

W. A. COMPTON,
County Judge.
GEO. L. BASHAM,
W. B. WORTHEN,
18-3t Commissioners.

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received for the construction of approximately six miles of sewers, ranging from 8-inch sewers to 44 × 66-inch double-ring brick sewers, with appurtenances, until May 16th, 1893, at 6 o'clock, p. m., at the office of the City Clerk, of the City of Marinette, Wis.

Plans, profiles, specifications, and blank form of proposal may be found for examination at the office of the City Clerk.

The Common Council reserves the right to reject any or all bids.

J. K. SETRIGHT,
E. L. SHAW, City Clerk.
City Engineer. 18-2t

TO WATER-WORKS CONTRACTORS.

Sealed proposals are invited until 2 o'clock p. m., May 18th, 1893, for laying and setting pipe and appurtenances; also for erecting stand-pipe, engine-house and steam pumping plant complete, for Cambridge, Md., Water-Works. Certified check required with all proposals and penalty imposed for failure to complete contract on time. Right is reserved to reject any or all bids. Plans and specifications may be seen as follows:

THE CAMBRIDGE WATER CO.,
Cambridge, Md.
ISAAC S. CASSIN & SON, Engineers,
1404 N. 12 St., Philadelphia, Pa.
18-2t

WATER-WORKS AT FREDERICK, MD.

Sealed proposals will be received until Monday, May 15, 1893, by the Water Committee of Frederick, Md., for the construction of a reservoir, with a capacity of 6,000,000 gallons of water. Plans, specification and contracts will be on exhibition at the office of the City Registrar, City Hall, Frederick, Md. Blank form of plans, specification and contracts will be furnished on application. Each bid must be accompanied by a certified check to the amount of $200 as a guarantee of good faith. The right to reject any and all bids reserved.

JOS. F. EISENHAUER,
Chairman Water Committee.
Frederick, Md. 18-2t

STREET PAVING—NOTICE TO CONTRACTORS.

Sealed proposals will be received by the City Clerk of Lima, Ohio, by R. H. Gamble, Assistant Engineer in charge of street paving, until 12 o'clock noon (central standard time) of Thursday, May 25th, 1893, and opened immediately thereafter, for the paving of the Public Square, in the city of Lima, Ohio, with vitrified paving brick, together with all curbing, catch basins, drainage, etc., incident thereto, in accordance with plans and specifications on file in the office of the Engineer. All bids which are not made on forms furnished by the Engineer, or which are submitted on any other conditions than those stipulated in said form or specifications, will be rejected as irregular and informal. No bid will be considered unless accompanied by a certified check (payable to the City Clerk), or legal currency to the amount of five hundred (500) dollars, or by the City Clerk's receipt for the same. All such deposits will be returned to the unsuccessful bidders within ten (10) days from the award of contract. If the successful bidder shall refuse or neglect to execute a proper contract and furnish a bond acceptable to the City Council within ten (10) days from the time said contract shall have been awarded to him, the said certified check or currency shall be forfeited to and retained by the said city of Lima, Ohio, as liquidated damages for such refusal or neglect, otherwise the said deposit will be returned to him.

Samples of brick and stone and samples or models of iron sewer inlets must be submitted with bid.

The following are the approximate quantities of work:

12,635 square yards of brick pavement.
1,400 lineal feet of six (6) inch curbing.
8 circular curb corners.
6 catch basins.
12 iron gutter crossings.

Together with the necessary sub-drainage, etc.

The City reserves the right to reject any or all bids, before or after opening the same, which may be accompanied by samples of brick which in the opinion of the Engineer will not meet the requirements of the specifications; and to accept any proposal which may be deemed most proper.

Specifications, forms of proposal and other information may be had on application to R. H. Gamble, Assistant Engineer, Lima, Ohio.

By order of Council.
Lima, Ohio, April 25, 1893.
D. E. JONES,
President of Council.
J. B. DOUGLASS, City Clerk. 18-3t

PROPOSALS FOR WATER-WORKS.

The Borough of Pine Grove, Pa., will receive sealed proposals, addressed to the Chief Burgess, on and up to 8 p. m., May 23d, for the construction of their water-works, consisting of about 4¾ miles of pipe from 10 to 4 inches in diameter, with special castings, valves, valve boxes, 24 fire hydrants, etc. Earthen dam about 140 feet long and 18 feet high. Proposals will be received for the above work in whole or in part.

Each proposal for pipe-laying or building dam must be accompanied by a certified check, payable to the order of the Chief Burgess, as follows:

For pipe-laying..... $200.00
For building dam..... $150.00

as a guarantee that in case the contract is awarded the parties to whom such award is made will execute the contract with satisfactory security within five days after notification.

The Borough reserves the right to reject any or all proposals.

Specifications and plans can be seen and obtained of the Borough Clerk or their Engineer.

THOMAS B. HUGHES,
Chief Burgess.
AARON T. FELTY,
Borough Clerk.
FRED C. DUNLAP, Engineer,
No. 865 N. 29th St., Phila., Pa.
17-3t

U. S. ENGINEER OFFICE, CUSTOM House, Cincinnati, Ohio, April 29, 1893.—Sealed proposals for building dikes and dams in the Ohio River at the following locations, or any one of them, viz.: 4 dikes and 1 dam and shore protection at Clusters, 2 dikes and 1 dam at French Island, 2 dikes near Scuffletown, 1 dike near mouth of Tygwater River, 2 dikes near Mound City, will be received at this office until 2:30 p. m., May 29, 1893, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. AMOS STICKNEY, Major of Engineers, U. S. A. 18-4t

U. S. ENGINEER OFFICE, CHARLESton, S. C., April 15, 1893.—Notice is hereby given to all parties interested in the wreck of the schooner "Kate V. Aitken," in Swash Channel, Charleston Harbor, S. C., or in the cargo, if any, of said craft, that if same are not removed within 30 days it is the purpose of the Hon. the Secretary of War of the United States to treat said wreck and cargo as abandoned and derelict, and cause their removal, as prescribed by Sec. 4 Act of Congress, approved June 14, 1890. Sealed proposals for removing this wreck will be received at this office until 12 noon of May 15, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. 16-4t

U. S. ENGINEER OFFICE, ROOM H7, Army Building, 39 Whitehall Street, New York City, April 12th, 1893.—Sealed proposals for construction of dike in Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock, noon, on Friday, May 12th, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. D. C. HOUSTON, Colonel, Corps of Engineers. 15-4t

U. S. ENGINEER OFFICE, ROOM H7, Army Building, 39 Whitehall Street, New York City, April 12th, 1893.—Sealed proposals for hire of dredging plant for improving Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock, noon, on Friday, May 12th, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. D. C. HOUSTON, Colonel, Corps of Engineers. 15-4t

UNITED STATES ENGINEER OFFICE, Wilmington, Del., April 18th, 1893.—Sealed proposals for dredging and excavating for the construction of an inland waterway from Chincoteague Bay, Va., to Delaware Bay, Del., will be received at this office until 12 o'clock noon, May 18th, 1893, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. WM. F. SMITH, United States Agent. 16-4t

U. S. ENGINEER OFFICE, NEWPORT, R. I., April 14, 1893.—Sealed proposals, in triplicate, will be received at this office until 11 a. m., May 23d, 1893, and then opened, for furnishing and delivering 900 barrels of American hydraulic cement; of which 500 barrels are to be delivered at Fort Adams, Newport Harbor, R. I., and 400 barrels at Dutch Island, Narragansett Bay, R. I. For all information apply to W. H. BIXBY, Captain, Corps of Engineers, U. S. Army. 17-4t

OFFICE OF LIGHTHOUSE ENGINeer Fifth District, Baltimore, Md., April 7, 1893.—Sealed proposals will be received at this office until 2 o'clock p. m. of Wednesday, the 17th day of May, 1893, for furnishing the materials and labor of all kinds necessary for the completion, delivery and erection at the sites of the metal work of Cape Charles and Hog Island Light Towers, Virginia, for a fixed sum for each light tower, or for an aggregate sum for both towers. The bids most advantageous to the United States Government will be accepted. Plans, specifications, forms of proposal and other information may be obtained on application to this office. The right is reserved to reject any or all bids and to waive any defects. ERIC BERGLAND, Captain of Engineers, U. S. A., Lighthouse Engineer, Fifth District. 15-5t

U. S. ENGINEER OFFICE, WILMINGton, Del., April 11, 1893.—Sealed proposals for dredging in Cambridge Harbor, Md., will be received at this office until 12 o'clock noon, May 11, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. WM. F. SMITH, United States Agent. 15-4t

CURRENT PRICES.

RAILS.

New York: $29 at eastern mills and at tidewater; girder rails, $31 to $33; old rails, $16.25 to $16.50 for iron, and $12.75 to $13 for steel. Pittsburg: $29 for standard sections; old rails, $19.50 for iron and $15.50 for steel. Chicago: $30 to $32 for standard sections; old rails, $17 to $17.50 for iron and $11.25 to $15 for steel.

TRACK MATERIAL.

New York: steel angle bars, 1.5 to 1.6 cts.; spikes, 1.85 to 1.95 cts.; track bolts, 2.4 to 2.5 cts. with square and 2.5 to 2.6 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron and steel spikes, 2.15 cts.; iron track bolts, 2.7 with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.6 to 1.7 cts. for iron and steel; spikes, 1.95 to 2.05 cts. at mill; track bolts, 2.6 to 2.65 cts. with hexagon nuts.

PIPE.

Cast iron, $20 to $30 per ton, according to quantity and location. Wrought iron discounts as follows at Pittsburg: 60% and 50% on black and galvanized butt welded; 67½% and 57½% on black and galvanized lap welded. Casing, 57%.

FOUNDRY PIG IRON.

New York: $13.25 to $15.25. Pittsburg: $12.75 to $14. Chicago: $12.75 to $14.25.

LEAD.

New York: 4.05 to 4.15 cts.; Chicago: 3.95 to 4 cts.; St. Louis: 3.85 to 3.87 cts.

STRUCTURAL MATERIAL.

New York: beams, 1.8 to 2.25 cts.; channels, 1.85 to 2 cts.; angles, 1.75 to 1.9 cts.; tees, 1.85 to 2 cts.; universal mill plates, 1.85 to 1.9 cts.; steel plates, 1.8 to 2 cts. for tank, 2.1 to 2.25 cts. for shell, 2.25 to 2.5 cts. for flange, 2.5 to 2.8 cts. for box. Pittsburg: beams, 1.65 to 1.7 cts.; channels, 1.65 to 1.7 cts.; angles, 1.65 to 1.7 cts.; tees, 1.85 to 1.9 cts.; Z bars, 1.8 to 1.9 cts.; universal mill plates, 1.65 to 1.75 cts.; sheared steel bridge plates, 2.1 to 2.25 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.6 to 1.65 cts. for tank, 1.75 to 1.8 cts. for shell, 1.9 to 2 cts. for flange, 3 to 3.25 cts. for heat firebox, 1.75 to 1.8 cts. for bridge. Chicago: beams, 1.9 to 2 cts.; channels, 2.27 to 2.5 cts.; angles, 1.85 to 1.95 cts.; tees, 2.2 to 2.3 cts.; sheared iron plates, 1.9 to 1.95 cts.; universal plates, 1.85 to 1.95 cts.; steel plates (at mill), 1.85 to 1.95 cts. for tank, 2.1 to 2.15 cts. for shell, 2.25 to 2.3 cts. for flange, 3.5 cts. for firebox.

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